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COLLINS, PRINTER.

Volume III., will be found the diseases of the various systems and organs, and the concluding portion will be devoted again to general practical matters—operative and minor surgery, gunshot wounds, hospitals, and some topics not readily classified. It is believed that an examination of the plan thus briefly sketched will show it to be not only philosophical but extremely simple and convenient. One special advantage of this rearrangement is, that it admits of general titles on the back of each volume, by means of which the place of any subject will be at once indicated. Moreover, with a copious index at the end of each volume, and a more general one at the conclusion of the whole work,⁶ the reader will find the labor of reference to any special point greatly facilitated, and the practical value of the book proportionately increased. The appendix to the article on Inflammation, which in the original was unavoidably placed nearly at the end of the whole book, has been added to the article itself in the first volume.

With regard to Anæsthetics, it is well known that in England chloroform has been, at least until within a few years past, much more generally used than in this country, where the majority of surgeons have preferred sulphuric ether, on account of its greater safety. It has not been thought needful to note this everywhere through the book when chloroform is mentioned, but the reader will probably make the substitution or not, according to his individual views on the subject. The original article on anæsthetics has been allowed to stand, but with an appendix from the pen of Dr. J. C. Reeve, of Dayton, Ohio, well known as an authority in this matter.

The illustrations of the original work have been almost without exception reproduced, and a very large number have been added. The aim of the Publishers has been to omit no available aid of this kind which could increase the value of the text.

As of necessity, the amount of material inserted by the Editors will be found to vary greatly in the different articles. Some were, upon careful revision, found to be wholly up to the present time, and in entire accord with the views and practice of American Surgeons. Others, from the nature of their subjects, required copious annotation. My earnest effort, as the Editor-in-chief, has been to adapt the work, as thoroughly as possible, to the wants of the reading and practising surgeons of this country.

JOHN H. PACKARD.

PREFACE

TO THE

SECOND ENGLISH EDITION.

THE second edition of this work will not be found to differ essentially in plan and arrangement from the first. Some changes have been made in the order in which the essays are placed, and the matter of each essay has been revised, so as to bring the work as far as possible up to the latest time, both in authorized teaching and practice; but the work remains in the main unchanged. The want of illustrations has been felt as a practical hindrance to its usefulness, and this want the Publishers, at the instance of the Editor, have determined to supply, as far as it could be done, without unduly increasing the cost of the book. The aim of the Editor and Contributors has been to supply illustrations which would be of real service, either in making the text intelligible, or in assisting the diagnosis of disease.

On one important subject a deviation from the natural arrangement has been found necessary: viz., the Pathology of Inflammation. The recent researches of Cohnheim and others have thrown so much doubt upon the accepted theories on this matter, and these researches were published so near to the time when the essay on Inflammation was required for the press, that it became necessary either to delay the publication of the whole until reasonable time had been given to test these authors' statements, or to postpone the pathological section of the essay on Inflammation until the completion of the work. For many reasons, the latter course seemed preferable; but it entails the inconvenience that the chapter on Inflammation will be found to be contained partly in the first volume and partly in the fifth.

In conclusion, the Editor has only to acknowledge gratefully, the favor with which the original work has been received, and to hope that this re-issue of it may deserve and obtain an equally favorable reception.

T. HOLMES.

PREFACE

TO THE

FIRST ENGLISH EDITION.

THE object of this book is to unite into a complete system the opinions and experience of many men, most of them Hospital Surgeons in London, and most of them writing on subjects of their own choice. As each subject must be treated with something of the completeness of a monograph, the work must necessarily be voluminous; but both Contributors and Editor have done their best to present each essay in as moderate a compass as the topic would allow. Where so many men unite in writing on parts of one great subject, it is hardly possible to avoid some differences of opinion; but none of much importance will, it is hoped, be detected in the following pages, and certainly none which can destroy the uniformity of the teaching.

The arrangement adopted in this work is as follows:—

I. The diseases which affect the whole system are first described, and this part comprises the essays ending with that on Cancer.

II. The next part treats of injuries which either involve the whole or a large part of the body, or which may be met with in any region. This extends to the end of the essay on Gunshot Wounds, in the second volume. These two parts comprise the whole subject of Surgical Pathology.

III. The various local injuries are next described; and in this part the anatomical order has been followed, the body having been divided into eight regions—the Head, Face, Neck, Thorax, Back, Pelvis, Upper and Lower Extremity. By this plan it was thought that the injuries which affect the same parts, and which in practice have to be diagnosed from each other, would be brought into the same part of the book and under the treatment of the same author.

IV. The principles of operative and minor Surgery, and of the employment of anæsthetics, follow the essays on local injuries.

V. The next part comprises the surgical diseases of the various organs of the body. These have been arranged according to the function of the parts affected: as diseases of the organs of special sense—the Eye, Ear,

and Nose; of the organs of locomotion—the Bones, Joints, Muscles, Tendons, and their Sheaths, etc.

VI. An Appendix completes the work, comprising the Principles of Surgical Diagnosis, of the Surgical Pathology and Treatment of Children's Diseases, the Construction and Management of Hospitals, and various miscellaneous matters which it was found difficult to bring under any of the previous heads.

This arrangement has been chosen, not as being free from objections, but as the best which suggested itself. The principal objection, perhaps, is the difficulty of separating the direct effects of injury from those diseases which frequently result from injury; but it is hoped that it will be found to have the merit of being intelligible, and of not making unnecessary artificial separations between things nearly connected in practice.

Any difficulty which may be found in discovering the place of any subject will be met by the analytical Tables of Contents at the head of each volume, and the copious Index at the end of the work.

For the plan of the work the Editor must be held responsible; the opinions expressed in each separate essay rest upon the authority of the writer, whose name is signed to it.

The Editor must express his deep sense of the honor done him in selecting him for the important task of preparing this book and seeing it through the press. He has endeavored to discharge his difficult duties to the best of his ability; had it not been for the unfailing courtesy and willing co-operation which he has experienced from all the Contributors, it would have been impossible to perform them at all; nor could the scheme have ever been realized but for the energy and liberality of the Messrs. PARKER. The Editor, as well as all connected with it, have to lament, in the premature death of Mr. PARKER, Junior, one who was warmly interested in the success of this undertaking, whose friendship the Editor was happy enough to form in consequence of their common connection with it, and from whom he constantly received valuable advice and encouragement.

T. HOLMES.

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CHROMO-LITHOGRAPHIC PLATES.

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- Fig. 2. Secretion from local suppurating sore

PLATE II.

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- Fig. 4. Secretion from indurated sore
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PART I.

GENERAL PATHOLOGY.

INFLAMMATION.

HECTIC AND TRAUMATIC FEVER.

COLLAPSE.

SCROFULA.

SYPHILIS.

TUMORS AND CANCER.

TUMORS.

CANCER.

MICROSCOPICAL STRUCTURE OF TUMORS AND
CANCER.

No. 3.



NORMAL
TEMPERATURE

G. G., et. 37. Compound comminuted fracture of tibia and fibula, with much contusion and laceration; cured. Surgeon, Mr. Solly.

No. 4.



NORMAL
TEMPERATURE

G. D., et. 55. Amputation above wrist, for disease. Erysipelas. Cured. Surgeon, Mr. Croft.

No. 7.

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 216. **Figure 209**
 217. **Figure 210</**

No. 8.

H. B., apt. 40, Ponce Avenue. Surgeon, Mr. Clark.

Plate II.

Fig. 1.

Indicated or not
 A. reticulata not
 A. reticulata not
 A. reticulata not
 A. reticulata not
 A. reticulata not



792

*in saturated or
unsaturated exchange*

44

$$H^2(X, \mathbb{Z}) = H^2(X, \mathbb{R}) \oplus H^2(X, \mathbb{C})$$

process of lymphatic absorption. In either case, where the seed takes root, there will it germinate and produce its natural consequence. The morbid process which ensues terminates surely, and without any period of incubation (in the ordinary acceptance of the term), in the formation of a small quantity of matter which always has peculiar properties. This matter is *pus*, and *pus* which has the property of always reproducing its specific action when again applied to another part of the same body, or when inoculated upon another person. This *pus* is therefore called *specific*. To the naked eye and to the microscope it presents all the characters of ordinary *pus*; but it has, in addition, its specific qualities, which are known only by their effects. It presents, as seen by the microscope and even by the naked eye, characters which distinguish it from the secretion of the indurated sore, or of the infecting form of syphilis. It consists of well-formed *pus*; and each globule is of nearly the same size, and distinct from the rest. If, in any doubtful case, some of the secretion from a sore be mixed with a little dilute acetic acid, and placed under the microscope, the distinctive characters of the *pus-nuclei* will be seen, as represented in Plate I. fig. 2. The appearances produced are quite distinct from those which are afforded by the secretion from an infecting sore treated in the same manner, as will be more fully shown in the next section.

When this specific *pus* has produced its natural effect either in a lymphatic vessel or in a lymphatic gland, the fresh portion of *pus* thus generated produces a fresh specific irritation, and this irritation produces an abscess which, breaking externally, discharges its contents. In such a case the matter in the interior of the gland, or lymphatic vessel, constantly retains its specific characters; but that which during the process of suppuration is formed outside the vessel or gland is ordinary non-specific *pus*. As the disease advances, these two secretions may be mixed together, and then the whole acquires the characters of the specific fluid, and the surface of the whole sore will become inoculated.

Lymphatic absorption from a suppurating syphilitic sore then necessarily produces a suppurating bulbo. Any attempt to prevent such an affection from suppurating is entirely futile. The disease within the lymphatic system is the same, and runs a similar course, as that upon the surface of the body.

The disease now described is not beneficially influenced by mercurial treatment; and inasmuch as it has no tendency when left to itself to infect a patient's constitution, any mercurial treatment in order to

prevent such an infection is superfluous. The suppurating sore will sometimes be treated with a variety of applications, sometimes without proximate effect upon the cure. In a case lately under St. George's Hospital, nature lasted four months, little influenced by treatment; patient at the end of it very good recovery, and without having taken any medicine. [American writers are in applying the term "used by Clegg, to the lesion of Mr. Leo as the "suppurating chancre." The complete every feature of syphilitic career of each of its forms, may be regarded as great achievements of the author. Without, however, discussing the long-vexed question respecting the reality or duality of the characters, mere statement of which use of terms, it is sufficient to say that the author practically re-terminates upon which it is lay emphasis. Consistent with the word "syphilitic" applied to that venereal and complicated cases, is new disease syphilis.

The progressive relation of the chancreoid lesion, not elsewhere for several years, apparently succeeded by frequent occurrence. In wars in Europe have effect in the production removing large bodies of their homes to the continent and commerce.

Beginning commonly in the manner described, the chancreoid is not rarely a suppurating abrasion of the skin. This is usually a dental inoculation of the skin with the virus of the chancre, for example, an herpetic lesion; or the open mouth have been directly infected of these varieties does frequently from that description. In either form, it should be that the sore is frequently from the first, or as the disease accidental auto-inoculation limited to the corona spreading over scrotum, penis.

Lasting for six or eight months, described in the text, in pigmented chancreoids, or in primary ulcers or sequelae

•

•

Plate 2

2

$$T_{\mu\nu} = \frac{1}{2} \rho_{\mu\nu} + \frac{1}{2} \rho_{\nu\mu}$$

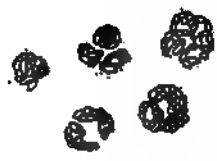
$$T_{\mu\nu} = \frac{1}{2} \rho_{\mu\nu} + \frac{1}{2} \rho_{\nu\mu}$$

$$T_{\mu\nu} = \frac{1}{2} \rho_{\mu\nu} + \frac{1}{2} \rho_{\nu\mu}$$

$$T_{\mu\nu} = \frac{1}{2} \rho_{\mu\nu} + \frac{1}{2} \rho_{\nu\mu}$$

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$$T_{\mu\nu} = \frac{1}{2} \rho_{\mu\nu} + \frac{1}{2} \rho_{\nu\mu}$$

Plate II.

Fig 1

Indurated ore, not
decomposed, not
exposed to air, in
the state of
the ore.



Fig 2

Indurated ore, not
decomposed, not
exposed to air, in
the state of
the ore.

Fig 3

Indurated ore, not
decomposed, not
exposed to air, in
the state of
the ore.

PART II.

MORBID PROCESSES.

ABSCCESS.

SINUS AND FISTULA.

GANGRENE.

ULCERS.

of which sufficiently numerous instances may be seen to allow of their being described in general terms. A closer and more express study of the subject would certainly lead to the discovery of many forms which are not here indicated, because they are known to the writer by only a few instances, incompletely observed. The characters of ulcers, if more fully studied, both in well-marked and in modified and complicate examples, would be found as various, and, severally, at least as well-defined, as are those of cutaneous eruptions; and with the better diagnosis that would be thus attained, there might follow a much better discrimination of the means of treatment appropriate for each.

PART III.

INJURIES IN GENERAL.

CONTUSIONS.

WOUNDS.

BURNS AND SCALDS.

ANIMAL POISONS.

WOUNDS OF VESSELS.

FRACTURES.

DISLOCATIONS.

PART IV.

COMPLICATIONS OF INJURIES.

ERYSIPELAS.

PYÆMIA.

TETANUS.

DELIRIUM TREMENS.

HYSTERIA.

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PART V.

INJURIES OF REGIONS.

INJURIES OF THE HEAD.

INJURIES OF THE FACE.

INJURIES OF THE NECK.

INJURIES OF THE CHEST.

INJURIES OF THE BACK.

INJURIES OF THE PELVIS.

INJURIES OF THE UPPER EXTREMITY.

INJURIES OF THE ABDOMEN.

INJURIES OF THE LOWER EXTREMITIES.

1

1

the discharge from the nose ceased, the cheek regained its normal size, and the man recovered. It turned out that the lint had been used, steeped in laudanum, for plugging the socket and relieving a temporary attack of face-ache.

The presence of a foreign body in the nostril may become the cause of ozena, and lead to the secretion of a fetid puriform discharge; and attention has lately been directed to this subject by some of the surgeons of St. George's Hospital, who have pointed out the propriety in doubtful cases of careful examination, under chloroform [or ether], of the affected part.

In September, 1859, two little boys, between six and seven years of age, came under the care of Mr. Prescott Hewett. The first was said to have passed a plum-stone up the nose, and the event was supposed to have taken place a year previously. On examination, some foreign substance could be recognized, with the probe, high up in the nostril, and wedged against the spongy bones. It was impossible to deal with it until chloroform had been given, and this having been done, a long screw (more than an inch in length) was with some difficulty extracted. The child soon recovered. The other had been under the care of various practitioners for the last three years, on account of "discharge from the nose, ozena," etc., but without any suspicion entertained of a foreign body being present. On examination, Mr. Hewett recognized, at the top of the nostril, a black colored substance, which seemed hardly like a portion of the natural tissues. The child was therefore put under the influence of chloroform, and a small black button (such as is used on boots) was extracted. The ozena and discharge from the nose soon disappeared.¹ Another case has been described, in which a piece of wood-shaving was removed under similar circumstances.

[Foreign bodies in some cases may be loosened and washed out of the nose by means of Thudichum's douche. Of course the stream of water, which ought to contain a little common salt or chlorate of potassium, should be directed into the opposite nostril. This means, if not successful the first time, may be repeated at intervals, and in those cases in which ulceration has been excited by the presence of the body, the douche will serve a double purpose, to remove the accumulated secretion and to displace the offending body.]

For the treatment of the scars resulting from burns and scalds of the face, vide PLASTIC SURGERY. I may here remark, that, after the application of heat in any form to the integument, the great point to ascertain is, whether the entire thickness of the skin has been destroyed. If only the superficial layer has been disorganized, repair goes on, without subsequent contraction, by means

of a number of small florid and well-formed granulations. If, however, the whole thickness of the integument is involved, then to a certainty contraction will follow. The eyelid will be drawn downwards, producing ectropium; the nares may be narrowed and twisted; the mouth drawn downwards and to one side, exposing the teeth and jaw. The features cease to be in harmony, and the teeth become horizontal. Surgical skill is often in vain invoked to arrest the contraction; it goes on steadily and slowly, however we may arrange the plasters and dressings, or in whatever position the patient may be placed. It is in general after a lapse of years that relief from the deformity is sought; and then the disappointment attending plastic operations, or partial divisions of the contracted bands, has been too generally experienced to need comment. I would call especial attention to the treatment of these contractions by slow, gradual extension, the advantages of which proceeding merit more general attention: the contractile material of the cicatrix becomes slowly absorbed, and when once absorbed is not reproduced; the hard and puckered skin becomes soft and yielding, though never like healthy integument; and results are ultimately attained which surpass expectation. The objection to this practice, that it is slow and involves a treatment of many months, is not tenable, for the treatment of wounds made in the performance of plastic operations on cicatrices is very frequently more tedious still; and then it must be remembered, that after the wound has healed, a process of contraction goes on again in every part allied in its nature to a cicatrix, and in many cases the surgical operation has to be repeated.

Cases occasionally present themselves in which the cheek becomes adherent to the gums, in consequence of sloughing of the lining membrane, and subsequent granulation and union of the adjacent surfaces. The movements of the mouth are always so much impaired that the power of mastication is lessened; and it occasionally happens that the teeth are so firmly clenched, that there is difficulty in giving to the patient the necessary nutriment.

I saw, in 1845, a lady to whom this accident had occurred, after profuse salivation, directed for the purpose of relieving her from an attack of psoriasis. The soreness of the mouth caused by the mercury was aggravated by the presence of some carious teeth, which the surgeon refused to remove. A very strong band of adhesion formed, which was twice divided by another surgeon; the relief thus afforded was temporary, and the closure of the mouth recurred in the course of a few weeks. About the same time I saw a boy, all of whose teeth were sound; but in whom sloughing of the mucous membrane of the cheek had taken

¹ Brit. Med. Journal, Sept. 24, 1859.

bone. A year and a day afterwards the man returned, wishing to get rid of his present suffering at any price. The left ramus of the jaw had been entirely separated and lost, the cicatrices by which it had come away being quite visible; a firm band was felt under the skin, passing down in the same situation to the middle piece of the jaw. The middle piece still contained one canine, two bicuspidate, and one molar, teeth. The right ramus remained in the socket, but the broken end was pulled up and pushed into the soft parts. The whole cheek was swollen; the angle of the jaw was carious and protruded through the skin. M. Ancelon removed the entire right ramus. The middle piece remained attached to the fibrous cord on the left side, and the patient regained sufficient power to masticate light food.¹

When fracture occurs about the middle part or body of the lower jaw, the signs are sufficiently obvious. There is mobility of the parts, crepitus, and irregularity in the line of the teeth; the gums are torn and bleeding, the mouth is usually partly open, and the saliva dribbles away. It is commonly affirmed that, when the middle portion is broken on both sides of the symphysis, the detached fragment is drawn down by the depressor muscles of the lower jaw; such is sometimes the case, but the direction of the force applied must also be taken into consideration, as well as the inclination of the fractured surfaces. When fracture occurs in the ramus, or about the neck or coronoid process of the bone, the displacement is either inconsiderable, or else in such a situation as to be recognized with difficulty. The surgeon must then trust to careful examination and inquiry into the character of the accident, remembering that the presence of deep-seated fixed pain, on examination, in a bone, after a severe injury, is a good diagnostic mark of fracture. There are some who speak of "compound" fracture of the jaw, where the gum is lacerated or the integument torn. The term, perhaps, is scarcely applicable in the sense in which it is used in cases of fracture of the long bones. In the latter the gravity of the complication consists in the laceration of the mass of soft parts, muscles as well as integument, covering a dense hard bone, such as the femur or humerus. Inflammation and suppuration are apt to ensue, producing exhausting discharges and hectic fever. In the former case, the laceration of the gum, or of the integument covering the jaw, is a matter of comparatively little moment; it adds nothing to the severity of the case; the soft parts unite readily enough, being a thin and highly-organized layer. The bone, also, more highly organized than the long bones, throws out, without effort, the proper material for re-

pair. Beyond, therefore, the pain which such an accident causes, there is little ground for anxiety in ordinary cases, either to the surgeon or to the patient.

The treatment consists in maintaining the parts in steady apposition for from four to six weeks. During this period the patient must not attempt to chew solid food; he must live on soups, sopped bread, and other similar substances, which can be easily swallowed. He will not feel disposed to talk much, and, in so doing, should avoid moving the jaw. As a rule, he will content himself with merely expressing his wants. If the fracture be not attended with much violence to surrounding parts, there is no necessity to prescribe absolute rest; but, in cases where the soft structures are much lacerated and bruised, bed is the fittest place until swelling has entirely subsided.

Various substances are employed for the manufacture of a splint. That in most common use is gutta percha, which, when properly heated, adapts itself to the injured parts. The exact size and shape having been previously ascertained and determined, the gutta-percha should be cut accordingly, and then immersed in water heated to just below boiling-point. In the course of a very few minutes it becomes soft and perfectly pliant. It should then be removed from the water, and pressed for a moment between the folds of a dry towel. In this state, moderately dry and deprived of superfluous heat, it is to be put on the surface intended for support, and bound thereto by a roller. In the case of the jaw, the "four-tailed" bandage is of use in attaching the parts firmly to the head. The common causes of failure in the making of gutta-percha splints arise from the following circumstances. First, the water is not hot enough; secondly, the accessory appliances are not quite ready at hand; and thirdly, the surgeon is not quick enough. The whole proceeding should occupy a very brief space. Unless the gutta-percha is properly heated, it does not adapt itself, and the support which it affords is imperfect. A preparation of vulcanized india-rubber, now much used by dentists for the construction of artificial palates, etc., is also applicable for the purpose now before us. Card-board, leather, or even the four-tailed calico bandage stiffened with starch, may be employed when other materials cannot be obtained.

[For the greater number of uncomplicated fractures of the lower jaw the bandage suggested by the late Dr. J. Rhea Barton has been found, in Philadelphia, to be the most useful. This bandage consists of a piece of muslin two inches wide and five yards long. In applying it the initial end is placed midway between the

¹ Double Fracture de la Machoire inférieure, *Gaz. des Hôpit.*, 1854, p. 550.

Suicidal wounds of the neck are comparatively common.¹ They are more common in this country than on the Continent.² These wounds are almost always incised, and are often lacerated, with more or less jagged edges. They are ordinarily made from left to right, and obliquely downwards or transversely across the throat. They seldom sink so deeply into the side of the neck as to reach the great vessels. The larger extent of the wound is, in most instances, on the left of the middle line; but this is not invariably the case, even though the right hand have been used.³ Dieffenbach records the case of a young man who, having taken a razor in each hand, at the same moment cut across his neck from left to right, and from right to left. The wounds crossed one another over the larynx and trachea.⁴ Most frequently the suicide makes but one gash. Sometimes, however, several wounds are inflicted before the fatal or final one is made. It is important to bear in mind that in consequence of its elasticity and mobility, the skin of the neck is easily thrown into folds and irregularly stretched; and thus several distinct cuts may be produced by a single stroke of the knife. The jagged and uneven appearances often presented by continuous wounds may be explained, to a certain extent, in the same manner.⁵

Punctured wounds are occasionally, though rarely, made in this region with suicidal intent. Lord Castlereagh, as is well known, destroyed himself by thrusting a penknife through his carotid artery. His method was attempted shortly afterwards by many would-be suicides, but in most instances without fatal result. Laugier⁶ quotes the case of a lunatic, who, having penetrated his larynx by the point of a penknife, divided his thyroid cartilage into eight parts by turning the knife in various directions.

Suicidal wounds of the throat are most common among men of intemperate habits and broken health, who have passed the middle period of life. Sometimes they are inflicted during delirium; sometimes in fits of extreme despondency; sometimes, but not often, under the influence of privation or pain, or of distress of mind, delusion, or fear. Under any such circumstances the condition of the sufferer is

unfavorable alike to recovery from the shock of the injury, and to subsequent repair of the damage sustained. Hence, these wounds are more likely to prove fatal than accidental or homicidal wounds of similar extent and severity. Hence also, special care and watchfulness are necessary in their treatment.

Wounds of the neck may be divided, for convenience of description, into those inflicted behind, those in the lateral regions, and those in front. Very often, however, the wound extends from one region to another.

1. *Wounds of the back of the neck* are less likely to prove dangerous to life than those in front. But it has been stated that they "often produce a palsied condition, and frequently a wasting of the lower limbs." "Wasting of the testicle and loss of the generative power" are also said to have been observed.¹ It is difficult to obtain good evidence in support of these statements, and it is probable that they apply only to cases in which the spinal canal has been penetrated.

M. Legouest saw in Algeria many cases in which very deep transverse wounds in the back of the neck had been made by the Arabs in their attempts to decapitate the soldiers who had fallen into their hands.² "The results were satisfactory, in spite of the size and thickness of the cicatrices;" and no such effects as those above alluded to appear to have been produced.

A deep wound in the upper part of this region, especially if made when the head is bent forwards, may penetrate between the occiput and atlas, or between the atlas and axis, and implicate the spinal cord or its membranes. There is no other part in which the cord can be so easily reached by a pointed or cutting instrument; nor is there any in which a wound of the cord is so likely to prove speedily fatal.

When the cord is wounded, sensation and the power of voluntary motion are instantly lost to an extent corresponding to the injury inflicted. A flow of cerebro-spinal fluid from the wound also occurs. This is often considerable, and sometimes continues for several days. Cases have happened in which the spinal membranes have been cut, but the cord has escaped almost intact. In such cases, an escape of cerebro-spinal fluid has been observed.

M. Laugier³ refers to instances of infanticide accomplished by means of a long needle passed between the atlas and axis into the cord.

¹ See previous note.

² The statistics of Brierre de Boismont 'Du Suicide,' Paris, 1856) show out of 4595 cases of suicide only 121 by cut throat.

³ In St. George's Hospital Reports, 1866 (p. 368), reference is made to a recent example.

⁴ Dieffenbach, *Sur les Plaies du Cou*. Archives générales, 2^e série, t. vi., p. 237.

⁵ For the medico-legal bearing of this point, see Casper, Sydenham Society's translation, vol. i., p. 129.

⁶ Dictionnaire enc. (30 vol.), t. ix., p. 168.

¹ Chelius, *System of Surgery*, translated by South, vol. i., p. 437.

² L. Legouest, *Traité de Chirurgie d'Armée*, Paris, 1863, p. 407.

³ Op. cit.

into the air-passages, very generally implicate other important parts also. Such wounds are liable to be attended by certain dangers and complications more or less common to all, whatever their precise situation; and by others which vary with the particular structures involved.

Some idea as to the relative frequency with which the different portions of the air-tube are wounded, may be gathered from the following summary of 158 unselected cases, of which I have obtained particulars.

Situation of Wound.	Number of Cases.
Above the hyoid bone	11
Through the thyro-hyoid membrane	45
Through the thyroid cartilage	35
Through the crico-thyroid membrane, or cricoid cartilage	26
Into the trachea	41

The sources of danger, and after-complications common to most of these wounds, irrespective of their precise situation, are as follows:

1. Hemorrhage, arterial or venous, may prove fatal almost instantly, or very speedily and before assistance is at hand. Sometimes, after having completely ceased for a time, during syncope or from some other cause, it recurs to a serious extent. This is especially likely to happen when a small opening has been made into one or other of the great vessels. As a general rule, the great vessels escape in cases of suicidal cut throat. They owe their comparative immunity, in the first place, to their elasticity and mobility, and the consequent ease with which they are carried, as it were, with or before the knife; and in the second place, but not less notably, to their situation. When a gash is about to be made in the upper part of the neck, the head is thrown back, and the pharynx is brought well forward. The incision must be deep indeed to reach the carotids or jugulars. Again, when the incision is over the larynx, the cartilages oppose so much resistance that the power of the suicide is generally expended before the needful depth is attained. Lastly, when the incision is still lower, the sterno-mastoids contract spasmodically on the stimulus of the knife, and defend the deeper structures. It is probable also, as pointed out by Mr. Hilton in his *Anatomical Lectures*, that when the windpipe is opened below the glottis, air immediately escapes from the lungs; consequently, the chest-muscles which act upon the upper extremity lose to a certain extent their support, and the arm falls. Thus, the would-be suicide, if he have the desire, may be deprived of the ability to carry his attempt further.

2. Blood may be drawn, or may flow into the air-passages faster than the sufferer can expel it; and asphyxia may quickly

result. Or a clot of blood may get into the larynx, and destroy life.¹

3. Air may enter a wounded vein, and cause sudden death, or give rise to alarming symptoms, which may either subside, or ultimately lead to a fatal result. This accident is most likely to occur if one of the large veins at the root of the neck has been opened, but not cut through. It may happen, however, in wounds of the smaller veins, and even though the seat of injury be comparatively high in the neck.²

Le Gros Clark mentions a recent case in which the incision was above the hyoid bone. Death resulted in about twenty-four hours. Dyspnoea came on gradually, and increased until life was extinct. "At the autopsy, the blood in the heart was found churned up and frothy. . . . Investigation at the seat of injury suggested that a half-divided vein, which had been ligatured only on its distal or bleeding side, had slowly absorbed air, the admixture of which with the blood had proved fatal."³

4. The divided structures may be so displaced as to impede or absolutely obstruct respiration. For example, if the incision is above the hyoid bone, the tongue may be cut through, and its posterior portion falling back, may occlude the larynx, and produce suffocation. Such a case has lately come under my observation in Guy's Hospital.

If the incision is between the hyoid bone and the thyroid cartilage, the epiglottis may be divided, or separated from its connections, and may give rise to alarming symptoms.

In a case of cut throat recorded by Mr. Houston,⁴ the epiglottis, loosened from its upper and lateral attachments, was left hanging by its pedicle to the back of the pomum Adami, and having fallen over the rima glottidis, obstructed respiration so completely that, within a few minutes after the accident, symptoms of suffocation ensued. The epiglottis was raised, brought over the edge of the thyroid cartilage, and secured by a single stitch to its anterior surface. Respiration returned. The man in a short time sat up, and attempted to speak, but was unable to articulate.

If the laryngeal cartilages are cut through, a detached portion of one or other may get into the glottis.

A remarkable instance is mentioned by Sir

¹ See Hilton's *Clinical Lectures*, Guy's Hospital Reports, 3d Series, vol. xiii., p. 31.

² See p. 475 of this work, on "Entrance of Air into Veins."

³ Lectures on the Principles of Surgical Diagnosis, delivered at the Royal Coll. of Surgeons, p. 225; also *British Medical Journal*, August 21, 1869.

⁴ *Dublin Hospital Reports*, vol. v., p. 315, cited by Ryland.

spiratory effort may draw some portion of flame or hot air at any rate as far as the glottis. The intense inflammation of the respiratory tract, which sometimes immediately follows an extensive burn, may be thus explained. Such inflammation must, however, be distinguished from the low form which so frequently supervenes at a later period.¹

Out of twelve cases of inflammation of the larynx from inhalation of flame, under observation at St. George's Hospital, in nine the neck and face were severely burnt; in three the superficial burn was confined to the lower limbs and lower part of the trunk. In a few of these cases there was difficulty of respiration almost from the time of the injury; in others, symptoms of dyspnoea came on a few hours afterwards, or on the first or second day following the injury. Death occurred in the majority of cases on the first or second day, but in two cases as late as the eighth or ninth day. In those cases in which the burn had extensively injured the face and neck, symptoms of dyspnoea were noted very early. In the two cases in which death did not take place until a much later period, the burn affected only the lower limbs and lower part of the trunk; and difficulty of breathing did not come on until the second day after the injury, and at first was only slight. In both of these cases the affected parts were extensively and deeply injured; but it is proper to add that the patients were at a period of life when the constitutional powers are most capable of supporting the shock of such an injury. The patients in the other cases were children or aged persons.

The post-mortem appearances are as follows: The mucous membrane of the mouth is of a dark livid color, or inflamed and oedematous. The tongue is occasionally much injected. The mucous lining of the fauces, and sometimes that of the pharynx, is of a bright scarlet hue. The vascularity ceases, as a rule, at the junction of the pharynx and oesophagus. In one case, however, the redness was found to extend about an inch along the oesophagus; and in another, the whole length of the tube was of a dark livid color. The mucous membrane of the epiglottis, and of the aryteno-epiglottidean folds, is of a bright scarlet hue, and the submucous cellular tissue oedematous. The mucous lining of the larynx and trachea is inflamed, and shreds of lymph are occasionally seen on its surface. The lining membrane of the bronchi is often inflamed, and the tubes are loaded with thick yellow mucus. The pleurae are rarely affected. The lungs, in most cases, are either congested or sprinkled with patches of a vivid red color, or in more advanced stages of inflammation.

¹ *Treatise on the Diseases and Injuries of the Larynx and Trachea*, by Frederick Ryland, 1837, p. 274.

In very extensive burns respiration is commonly much accelerated; and consequently, the early detection of laryngeal inflammation may sometimes be difficult.

The treatment should be antiphlogistic. Calomel and antimony may be administered with advantage, in small but frequently repeated doses, as soon as croupy breathing indicates the existence of inflammation of the larynx. It must be borne in mind, however, that in the low forms of pulmonary inflammation, which so frequently follow severe burns, the very opposite treatment is required.

SCALD OF THE LARYNX.

Dr. Marshall Hall¹ appears to have been the first to publish a full account of this form of injury.

The accident happens usually to young children, and generally occurs during attempts to drink, by mistake, boiling water from the spout of a teakettle or other culinary vessel. The effects of such attempts, except in a few rare instances, are not, as might be supposed, to cause injury and inflammation of the oesophagus and stomach. Fluid of boiling temperature taken into the mouth is rarely, if ever, swallowed. It is arrested in its onward course by spasmodic action of the muscles of the pharynx, and efforts to expel it are almost instantaneously made. During these efforts it is possible that some of the fluid may accidentally enter the upper orifice of the larynx. It is more probable, however, that the result is produced in the following manner. The moment the hot water touches the interior of the mouth, acute pain is felt, and the child is instantly incited to scream. Preparatory to the scream, a sudden inspiratory effort is involuntarily but necessarily made. By this effort some of the boiling fluid, or hot steam from it, may be drawn into or towards the larynx. And thus the upper part of this portion of the air-tube may be scalded, together with the interior of the mouth and fauces. In many cases, however, the larynx itself is not actually scalded, but becomes speedily implicated by extension of inflammation and oedema from the fauces. In other cases spasm of the glottis may be excited, and give rise to the belief that the larynx has been directly implicated in the injury.

Immediately upon the receipt of the injury the sufferer screams violently, and, by instinctively applying both hands to the mouth, indicates the part injured. On examining the mouth, the whole inner surface is found inflamed, swollen, and vesicated, and the soft palate and fauces present similar appearances. This condition of the

¹ *Med.-Chir. Trans.*, vol. xii.

out having produced serious structural lesions.

The period at which expulsion may take place varies greatly, as will be seen from the following summary of 124 cases, in each of which spontaneous expulsion took place, and recovery ensued:

Period of Expulsion.	No. of Cases.
Immediately, or in less than 24 hours	5
In from 1 to 8 days	11
" 8 to 30 days	16
" 30 days to 1 year	64
" 1 year to 17 years	28
	124

Professor Gross quotes a very remarkable case (not included in the above summary) in which a portion of bone is stated to have been expelled after having been retained during a period of sixty years. Recovery followed.¹

2. Death may occur almost immediately after the entrance of a foreign body, from suffocation, or at a subsequent and very variable period from the same cause; or fatal hemorrhage may ensue, as in Rokitansky's² case, in which a small dart, drawn into the trachea, was forced into the innominate artery during a fit of coughing. In some cases in which the foreign bodies have been expelled, death from exhaustion or from some other cause has nevertheless resulted.

3. Various structural lesions of the most serious and often fatal character may be produced. For example, inflammation and oedema, or ulceration of the mucous membrane of the larynx may be set up if the body is retained in the upper part of the windpipe; or if it has descended lower, inflammation of the lung-tissues, followed by consolidation, or suppuration, ulceration, or gangrene, may be caused. Sometimes the lung-substance is traversed, and the

pleura reached. In such cases empyema occurs.

A good illustration is afforded by the case recorded by Mr. Carpenter³ in which a set of four false teeth, made of one piece of ivory, had been drawn into the air passage. Thirteen years afterwards the patient died after an attack of acute pleurisy. The right pleural cavity contained five pints of sero-purulent fluid, and in it were found the artificial teeth. A fistulous opening was observed on the surface of the lung, through which it was supposed the teeth had passed.

In some cases pulmonary emphysema results. In others the foreign body seems to serve as a nucleus around which tuberculous deposit may take place.

4. In some rare instances foreign bodies, known to have entered the air-passages, have been discharged, long afterwards, through abscesses or fistulous openings in the thoracic parietes.

5. Results more or less successful may follow surgical interference; or death may ensue, even though the foreign bodies have been removed.

As a general conclusion to this part of the subject, it may be definitely and decidedly asserted that life is in peril so long as a foreign body of appreciable size is retained in any part of the respiratory tract. At the same time, it is very uncertain at what period danger may become imminent, and in what way it may arise.

If this be true, it is obvious that the surgeon should lose no time in adopting such measures as may secure the safety of the patient, and aid the removal or expulsion of the foreign body.

The following carefully compiled summary of 554 cases must be taken for what it is worth, but it certainly seems to furnish a strong argument in favor of operative measures. It should be premised that no case is included in which death or expulsion immediately followed the accident.

RESULT OF CASES OF FOREIGN BODIES IN THE AIR-PASSAGES.

1. Cases in which no operation was performed:	Total No. of Cases.	Recoveries.	Deaths.
RESULT.			
Death without expulsion of foreign body	85		85
Spontaneous expulsion of foreign body	164	149	15
Expulsion after emetics (recorded as useless in 46 cases)	5	5	
Discharge at late period through thoracic abscess	7	2	5
Total of cases not operated upon	271	156	115

¹ Gross, op. cit. p. 172, quoted from New York Journal of Medicine, vol. vi., p. 23.

² Pathological Anatomy, vol. iv., p. 37 (translated by Day for the Sydenham Society).

³ Guy's Hospital Reports, 1st Series, vol. vii., p. 353.

ciated with it depend rather upon the conditions which render it necessary, or upon the ill effects of the retention of the canula in the air-tube. Such risks are proved by experience to be considerably less when the operation is performed on account of the presence of a foreign body, than they are when it is performed on any other account. The expulsion or extraction of the foreign body, if effected early, at once removes the great source of danger; and there is rarely any necessity for the prolonged retention of the canula, if even it has been found necessary to introduce it for a time.

The part of the windpipe which should be opened depends upon the position which the foreign body is believed to occupy; and also to a certain extent upon the age of the patient, and the size and character of the extraneous substance.

When the symptoms indicate that the foreign body is in the larynx, laryngotomy should be performed. First, because in such cases the symptoms are, as a rule, most urgent, and this operation is perhaps the most easily and most quickly performed; and, secondly, because an opening through the crico-thyroid membrane is near to the foreign body, and consequently is favorably situated for future proceedings. A large opening should be made at once. If the patient is very young, and the crico-thyroid space does not permit an opening of satisfactory extent, the incision may be carried downwards, and the operation of laryngo-tracheotomy accomplished. It frequently happens that the full access of air to the lungs, thus afforded, enables the patient to expel the foreign body at once, either through the glottis, or through the opening made. If expulsion should not immediately take place, the best plan is to introduce a canula and wait awhile. In the course of a short time the spasmodically contracted muscles of the larynx may become relaxed; and the foreign body being thus set at liberty, may be expelled. The canula secures freedom of respiration; and by its pressure serves to arrest hemorrhage, and to prevent the entrance of blood into the air-passage. When the patient has recovered from the immediate effects of the operation, if the foreign body still remains unexpelled, attempts may be made to dislodge it by removing the canula and exploring the larynx by means of a probe or catheter. Great care is necessary in doing this.

A case came under my observation some time ago in which a probe was repeatedly passed through the larynx up into the mouth, and the finger was also passed down through the mouth into the larynx, but no foreign body was discovered. The child seemed free from all distress, and breathed well through the larynx. It was supposed that the foreign body had been dislodged and coughed up, although

it could not be found. In the course of a few hours symptoms of suffocation suddenly came on, and before assistance could be rendered the child was dead. On examination a piece of apple-core was found in the rima glottidis, sticking across from one ventricle of the larynx. Several similar cases have been recorded.

If the foreign body is small and smooth and flexible, it may easily escape detection by a probe. A larger instrument should be used. The upper end of an elastic catheter may be recommended. The small ivory cap, with its flat top and hole in the centre, renders this instrument well adapted for the purpose; but it must be used with care.

After laryngotomy has been performed, and while the patient is breathing freely and safely through the canula, laryngoscopic examination may be made under favorable circumstances. If the foreign body is seen, it may be extracted by forceps, such as represented in Figs. 143 and 144.

In some cases, Mackenzie's Laryngeal Forceps (Fig. 145) may be advantageously used. The stem of this instrument is so slender as not to obscure the view. The blades (*b*) are so arranged that they can be turned by the screw (*a*), so as to open in any direction. They are closed by pressure upon the trigger (*c*).

Forceps constructed after the method of Messrs. Robert et Collin (of Paris) are very suitable. This method of construction is illustrated by Fig. 156 on page 908.

If the foreign substance cannot be extracted by such means, inversion and succussion of the patient may be tried. There can be no risk in making the attempt after the larynx has been opened; and in some instances success has resulted. The celebrated case of Brunel, to which reference has already been made, affords an excellent illustration. This method is most likely to prove successful if the foreign body is smooth, rounded, and heavy, as a piece of money, a shot, or a bullet.

But it may happen that the foreign body still remains fixed in the larynx after full opportunity has been afforded for its expulsion, and fair trial has been given to the several modes of treatment already specified. In such case the surgeon should not hesitate to cut through the thyroid cartilage (*thyrotomy*). The interior of the larynx may be thus fully exposed, and the foreign body certainly found and removed. The incision through the thyroid cartilage should be carried perpendicularly upwards from the opening in the crico-thyroid membrane already made, and should be strictly in the middle line; it may also be extended downwards if needful, through the cricoid cartilage (*crico-thyrotomy*.) This operation may be performed perhaps somewhat more advantageously if the trachea rather than

opposite a good light, or by aid of the frontal mirror of the laryngoscope.¹ When the patient is made to inspire deeply, and the tongue is depressed, the soft palate becomes raised, and the pillars of the fauces are widely separated. Under such circumstances, a small, sharp extraneous substance sticking in the folds of the palate, or between them and the tonsil, may often be seen. Sometimes the laryngeal mirror, properly directed, may be used with very great advantage.

If the foreign substance cannot be seen, the finger may be introduced into the pharynx, and gently passed over the surface of the mucous membrane. Care should especially be taken to explore thoroughly the sulci between the pillars of the fauces and the tonsil. If the foreign body should be low down in the pharynx and beyond the reach of the finger, it may sometimes be detected by means of the laryngeal mirror, or by examination with a long probe, or slender properly curved forceps. If after thorough search the foreign body remains undiscovered, it is sometimes better to wait until the next day, rather than to proceed to the indiscriminate wiping round of the pharynx so often practiced, and to which allusion has been already made. A bristle or a herring-bone, or any such substance, often becomes extricated after a time, and passes on down the gullet.

If a large foreign body seriously interferes with respiration, and is too firmly impacted to be at once removed, laryngotomy must be performed without delay. Further attempts at removal may then be made in safety; or if these fail, the foreign body may sometimes be pushed on into the stomach.

Habicot² relates a very successful case of this kind. A lad, fearing to be robbed, attempted to swallow nine pistoles wrapped up in a piece of linen. The packet could not pass the narrow part of the pharynx, and suffocation impended from its pressure. The windpipe was opened, and the boy's life was saved. The pieces of gold were subsequently pushed on into the stomach, and were discharged from the anus eight or ten days afterwards.

Coins, arrested in the lower part of the pharynx, obstruct the passage of the food and impede respiration in a degree varying, not only with their size and precise position, but also with the direction in which they lie.

I have, in two cases, extracted a halfpenny from this part of the pharynx, or the upper part of the œsophagus of a child. In one case the child had been absolutely unable to swallow even fluids since the accident, a period of six

days, but respiration was scarcely affected. The child was almost starved to death. In the other case, the child had been able to swallow fluids tolerably well, but the breathing was somewhat impeded and croupy, and the voice was lost. A few hours only had elapsed since the accident, but there was considerable and increasing distress. In the former case the coin was lying with its flat surfaces upwards and downwards, and on the upper surface was a little heap of condensed alimentary materials. In the other case the coin was fixed obliquely across the food passage, and its edges were upwards and downwards. In each case the coin was extracted without difficulty by means of the "money-probng" figured on page 908. In the case in which the coin was lying flat, some force was required to push the probng past it.

If the foreign body is very irregular, or covered with sharp projecting points, as an artificial tooth plate, and is too low down to be reached, or too firmly fixed to be removed without dangerous violence, the operation of pharyngotomy may be performed. This operation, which practically need not be distinguished from that ordinarily termed œsophagotomy, is discussed under this latter title on p. 909 et seq.

A foreign body may remain in the pharynx for a considerable period.

Dr. Ogier Ward¹ records a case in which a halfpenny was impacted in the pharynx of a child during eight months. Stridulous breathing and difficulty in swallowing came on immediately after the accident. The child could only suck one mouthful of milk at a time, and was obliged to withdraw from the breast at each attempt to swallow. One morning, after a severe fit of coughing the day before, the child took the halfpenny out of his mouth and gave it to his father. The halfpenny was much worn and corroded, and was thickly coated with dried mucus and masticated food. The patient gradually recovered.

Monro mentions a case in which an extraneous substance, arrested at the termination of the pharynx, became lodged in a sac of some length which descended behind the œsophagus.

Rokitansky² remarks that "sometimes small hard bodies, such as cherry-stones, give rise to serious occurrences, by causing at different parts of the œsophagus, but chiefly at the lower constrictor of the pharynx, the formation of diverticula."

It may reasonably be questioned, however, whether in such cases it would not be more correct to suppose that the small hard bodies got into, and perhaps increased, diverticula already existing, than to state that the diverticula were originated by the presence of the foreign bodies.

FOREIGN BODIES IN THE ŒSOPHAGUS.

A foreign body may become arrested

¹ See the chapter on the Laryngoscope, in vol. iii.

² *Mém. de l'Acad. de Chirurgie*, t. xii., p. 243.

¹ *Pathological Transactions*, 1848-49.

² *Pathological Anatomy* (Sydenham Society's Translation), vol. ii., p. 12.

may be safely pushed on. It occasionally happens that this is most easily effected by making the patient swallow a large bolus of food, and immediately afterwards a draught of water.

latter form is cable. The best the œsophageal MM. Robert et and improved by

Figs. 153, 154.



FIG. 153. Horse-hair Probang.

FIG. 154. Horse-hair Pro

Coins and such like bodies may often be extracted with comparatively little difficulty by means of a flat blunt hook connected by a thin slip of steel to the end of a long whalebone probang. (FIG. 155, b).

Fig. 155.



FIG. 155. Probang with sponge at end a. Money-probang at end b.

zer of London. principle upon made. It will b aration of the separation of the The forceps, blades closed, through the pharynx, and used the foreign body may then be open to seize the foreign body. If the attempt be successful, the body may be withdrawn; if not, delicacy and dexterity are necessary in extracting the mucous. In some cases, no other means may be excited, in the case of the contents of the contents

Fig. 156.



FIG. 156. Forceps for Extraction of Foreign Bodies.

If the foreign body is large and hard, with rough angular surfaces or projecting points, as a piece of glass or stone, or a fragment of bone of considerable size, it should always be extracted if possible. Long, properly curved forceps are most likely to be of service in such a case. The œsophageal forceps ordinarily made are of two kinds: in one the blades open laterally, and in the other antero-posteriorly. In some cases the former, in others the

place and expel it. But this treatment is only applicable if the body is of a soft, and especially if it is of a soft, or angular, consistency. It is not unlikely to be the case that the œsophagus, and pointed, will more firmly fix the foreign body, the administration of the contents of the contents

state that cases are on record in which large portions of meat, impacted in the pharynx and producing urgent symptoms of suffocation, have been got rid of by vomiting induced by the injection of a solution of tartarized antimony into the arm.¹ Other cases are recorded in which tartarized antimony and sulphate of zinc administered internally have led to satisfactory results.²

In some cases in which small bones have been lodged in the œsophagus it would appear that the constant swallowing of the dilute mineral acids has been of benefit. Professor W. Hall, of Baltimore, observes: "When a small bone is lodged in the fauces or œsophagus, it may be decomposed, or rendered so flexible that it will pass into the stomach, by the patient frequently taking diluted mineral acids. By this means I have succeeded in removing a small chicken-bone from the œsophagus, across which it had remained firmly fixed for several hours, although an emetic had been administered, and the curved forceps and probang had been frequently used, without success." It is right to allude to this method of treatment, but I venture to think it would be wrong to recommend its adoption.

When a foreign body, lodged in the œsophagus high up, obstructs respiration by pressure upon the trachea, tracheotomy must be performed. It may be possible to open the air-tube below the point where it is compressed. But even if this is impossible, an elastic tube may be passed down through the opening made, and respiration may be relieved until the foreign body can be removed.

Œsophagotomy.—If a foreign body in the œsophagus or pharynx can neither be extracted nor pushed down, nor got rid of by any ordinary means, it should be removed by operation, without unnecessary delay. It is true that in some cases extraneous substances have remained in the œsophagus during very long periods without producing much distress, or occasioning any serious injury to the neighboring parts. But it is equally true that in a large proportion of cases extensive suppuration and ulceration and very frequently fatal results have ensued. On the other hand the operation of œsophagotomy, or pharyngotomy, for the removal of foreign bodies has hitherto proved eminently successful. This operation may appear formidable in conception; but practically it is not difficult in execution, nor is it necessarily accompanied by any great risk. Experience shows that the chief danger is in delay.

This is very forcibly urged by Dr. Cheever, of Boston, U. S., in an excellent monograph on Œsophagotomy recently published.¹

Mr. Cock, referring to the recorded cases, writes: "It would appear that success has attended a speedy operation, whereas in those instances in which the use of the knife has been delayed until local inflammation, suppuration, or even sloughing has been established, and the patient's powers have been prostrated by fasting, pain, and want of rest, the operation has been fatal."² Again, Mr. Arnott, who was the first in this country to urge the importance and demonstrate the practicability of this operation, writes: "The rule of practice ought to be, when a solid substance, though only of moderate size and irregular shape, has become fixed at the commencement of the œsophagus, or low down in the pharynx, and has resisted a fair trial for its extraction or displacement, that its removal should *at once* be effected by incision, although no urgent symptoms may be present."³

It is probable that further experience will prove that the operation may be advantageously performed even in cases in which the foreign body is much lower down in the œsophagus than indicated in the above quotation. Indeed, in one of Mr. Syme's cases the foreign body was opposite the top of the sternum, and in one of Dr. Cheever's just below the top of the sternum.

More or less complete details have been published of 21 cases of œsophagotomy for the removal of foreign bodies. A summary of them is appended in a tabular form, pp. 912 et seq. Of the 21 cases 17 were perfectly successful, and followed by recovery. In 4 cases the patients died. But in these cases the foreign bodies were removed, and in no instance could death be attributed in any degree to the operation. In one case (Mr. Arnott's) the patient died of pneumonia, which existed before the operation was performed. In two cases (Demarquay's and Flaubert's) abscesses already existed. Respecting the fourth fatal case (Dr. Martini's) Mr. Cock⁴ makes the following remarks, the justice of which will scarcely be disputed: "When we read that the man was repeatedly bled, that sixty separate attempts at dislodgment were made with levers and forceps, that emmata of belladonna were employed, that finally tartar emetic was injected into the veins, followed up by clysters of vinegar and opium to counteract its effects; moreover, that during this ordeal the patient was unable to swallow even a drop of water, it is not surprising that he finally succumbed."

¹ Two Cases of Œsophagotomy for the Removal of Foreign Bodies, with a History of the Operation, by D. W. Cheever, M.D. 2d edit. Boston, 1868.

² Guy's Hospital Reports, 3d Series, vol. xiii., p. 8.

³ Med.-Chir. Trans., vol. xviii., p. 93.

⁴ Guy's Hospital Reports, 3d Series, vol. iv., p. 230.

¹ Dict. des Sciences médicales, t. vii., pp. 21,

22.

² Cooper's Dictionary, 7th edit., p. 1026.

cases, the patient before the operation had an excellent tenor voice; afterwards, he could only sing bass.

The accompanying woodcuts (FIGS. 157, 158) represent pretty accurately the tooth plates removed by œsophagotomy by Mr. Cock, to whose kindness I am indebted for permission to insert them in these pages. They serve to illustrate the general character of the foreign bodies that are most likely to render this operation necessary. When once such a body has become firmly impacted in the œsophagus, any attempt to remove it by forceps through the mouth must be wellnigh hopeless; and to push it forcibly onwards must be extremely dangerous. On the other hand, ample experience shows that the early performance of œsophagotomy is likely to be attended by the most perfect success.

Œsophagotomy has been several times practised in cases of disease, with the view of establishing an opening through which to convey food to the stomach. But in no instance has any satisfactory result been achieved.¹ In such cases, therefore, ex-

perience as well as *a priori* reasoning would seem to be opposed to the operation. [In a case which occurred lately in this city, a surgeon having performed œsophagotomy on account of a stricture, afterwards passed the tube, as was thought, down the gullet; meeting with an obstruction, the instrument was forced beyond, and a quart or so of beef-tea and milk was then passed through the tube; the patient died in a few hours, when it was found that the instrument had been driven along the outside of the œsophagus and through the diaphragm, and the food had been emptied into the peritoneal cavity.]

In the following table are summarized the details of all the cases of œsophagotomy for the removal of foreign bodies, which so far as I can ascertain, have hitherto been published. In compiling it, free use has been made of the table in Dr. Cheever's excellent monograph, than which, however, it will, I believe, be found more correct.

Bruns, Deutsche Klinik, 1865, p. 37. A remarkable case quoted at length in the Sydenham Society's Year Book, 1866. These cases are referred to by Cheever. An additional case is recorded by Mr. Willett, St. Bartholomew's Hospital Reports, vol. iv., 1868, p. 204.

¹ See Dublin Journal, May, 1845. Journal de Chirurgie, par Malgaigne, t. iii., 1845, p. 371.

TABLE OF CASES
In which the Operation of Esophagotomy has been performed for the Removal of Foreign Bodies.

No.	Date.	Sex and Age.	Nature of Foreign Body.	Point of Impaction.	Treat.					
1	1734	M.	Portion of bone, one inch long, six lines broad.	Esophagus; exact point not stated.	Not done.					no case reported, Bill., 1778, p. 14.
2			Probably a portion of bone.				traced.	Operation performed.	Recovery.	M. Roland, <i>ibid.</i>
3	1832	M.	Portion of beef-bone.	In esophagus at lower part of neck.	Attempts made to dislodge it; body touched.		traced on left side.	Operation on eighth day after accident, on left side of neck.	Speedy recovery.	M. Bégin, "Journ. univ. de médecine," 1833, t. xi., p. 93.
4	1832	M.	Large conical fragment of bone.	Esophagus; lower part of cervical portion.	Every means attempted to dislodge it; body touched.			Operation on eighth day after accident, on left side of neck.	Recovery.	M. Bégin, <i>ibid.</i>
5	1833	24	Spinous process of one of the dorsal vertebrae of a sheep.	Lower part of pharynx.	Emetics, and various attempts to dislodge it.		Operation not allowed until five weeks after impaction; incision on right side.	Death, fifty-six hours after operation.		Parumonia, which existed at time of operation. Mr. Arnott, "Med. which ex-Chir. Trans.," vol. xviii.
6	1842	M. 41	Portion of bone, dense, triangular; angles sharp.	Esophagus - perforation of body (lying on carotid).	Repeated attempts at extrusion. Frequent hemorrhage.		Operation, eighth day on left side.	Recovery by the twenty-sixth day.		D. J. Lavacherie, "Mémoires de l'Académie Royale de Médecine de

8	1853	M.	Small fish.	Pharynx; tail seen in mouth.	Vain attempts at withdrawal through mouth.	Operation after several days.	Recovery in six weeks.	mach and ducts num- inflamed.	336. Antonsz, "Lan- cet," vol. ii, 1854, p. 260. (From "Ceylon Miscel- lany," vol. i., No. 2).
9	1853	M. 44	Fragment of beef-bone.	Esophagus in neck.	Vain attempts at extraction.	Operation on ninth day.	Death on se- cond day after the operation.	Perforation in front and behind. Retro-phar- ngeal ab- scess reach- ing to sto- mach.	Flaubert, "Ga- zette des Hôpi- taux," 1857, No. 88, p. 349.
10	1854	F. 31	Franc piece.	Upper part of esophagus.	Repeated attempts at extrac- tion with Græfe's sound and forceps.	Operation on tenth day.	Death third day after operation.	Retro-phar- ngeal ab- scess open- ing into pleura.	Demarquay, "Ga- zette hebdom." Nov., 1861, p. 701.
11	1855		Portion of bone.	Esophagus; abscess formed.	Could not be reached through mouth.	Operation on sixteenth day.	Recovery in two weeks.		Syme, "Clinical Surgery," Edin., 1861, p. 91.
12	1856	M.	Gold tooth-plate, containing one false incisor.	Junction of pha- rynx and oeso- phagus. No ex- ternal projec- tion.	Vain attempts at removal with forceps and other in- struments; emetics.	Operation on fourth day; incision on left side.	Recovery in four weeks; voice per- manently altered from tenor to bass.		Cock "Guy's Hos- pital Reports," sec- ries iii., vol. iv., 1858, p. 217.

17	1866	M.	Portion of an- bone of codfish, one-half inch by one-fourth inch.	Junction of pha- ryn timer and oes- ophagus. No external pro- jection.	Spontaneous vomiting; pha- ryn timer explored by fin- ger and probang, causing rigors.	Operation on third day; incision on right side.	Recovery in six weeks.	Cheever, "On Esophagotomy for the Removal of Foreign Bodies," Boston, 1868.
18	1866	M.	Brass pin, one inch and a quarter in length.	Just below top of sternum. No projection.	Vomiting; long passed without obstruc- tion.	Operation on third day; incision on left side.	Recovery in five weeks; no adhe- sions.	Cheever. Ditto, ditto.
19	1867	M. 33	Silver tooth- plate, adapted to portion of gum occupied by upper inci- sors and can- ines, with pro- jecting rivets upon which the false teeth were formerly fixed.	Junction of pha- ryn timer and oes- ophagus.	Repeated attempts with pro- bang, forceps, etc. Could be grasped by the forceps, but not moved.	Operation on fourth day.	Recovery; could swal- low milk on the fourth day, solids on eighth day; dis- charged well on fifteenth day; no per- manent al- teration of voice.	Cock, "Guy's Hos- pital Reports," se- ries iii., vol. xiii., p. 1.
20	1867	F.	Brass pin.	Apparently op- posite left side of cricoid.	Attempts during four months.	Operation after four months.	Recovery.	Hitchcock, "Bos- ton Medical and Surgical Journ.," July 16, 1868.
21	1868	F.	Supposed to be a pin.	Junction of pha- ryn timer and oes- ophagus.	Various attempts.	Operation after eight months, left side.	Recovery.	Cheever, op. cit., p. 32.

In neither of the last two cases was any foreign body found. They are only quoted here as illustrating the small degree of risk incurred in this operation. Out of the twenty-one cases, seventeen were followed by recovery; and in the four in which death occurred, the complications which proved fatal existed before the operation was performed.

TABLE OF CASES
In which the Operation of Gastrotomy has been performed on account of Stricture of the Oesophagus.

No.	Date.	Sex.	Age.	Nature of Stricture, etc.	Mode of Operation.	After-Treatment.	Result.	Cause of Death.	Operator and Authority.
1	1849	M.	52	Epithelial cancer of the oesophagus. Symptoms of obstruction of five months' duration; rapidly increasing in severity; great debility; absolute inability to swallow; passage of bougie impossible; local ap- plications; nutri- ent enemata.	Chloroform given. Crucial incision through skin over rectus. Sheath and muscle similarly cut through, and peritoneum divided; great omentum exposed; by draw- ing this downwards, sto- mach brought into view; the greater curvature drawn up to the wound; an- terior wall punctured mid- way between pylorus and cardiac end; canula intro- duced (so made as to hold the stomach in contact with the abdominal parietes); plug put into canula.	Warm fomentations over ab- domen. Eau sucrée and beef-tea injected from time to time; greenish bile ac- cumulated in the stomach, escaped when plug was withdrawn from canula; no pain; patient slept at intervals, and was comfort- able during night; in the morning dyspnoea and quickness of breathing; rapid death.	Death fifteen hours after the opera- tion.	Exhaustion. Slight indica- tions of peri- tonitis.	Sédillot, "Con- tributions à la Chirurgie," t. ii., p. 484.
2	1853	M.	55	Malignant disease of the oesophagus, opposite the lar- ynx: great dys- phagia. Symp- toms nine months.	A long incision on the left side, two fingers' breadth from the median line, and two centimètres below false ribs; a second incision, per- pendicular to this, so as to make a cruciform incision. Stomach seized and fixed to abdominal wall by five or six points of suture car- ried through its peritoneal and muscular coats only; opening the stomach being postponed until it became united to the parietes. Chloroform given.	Two hours and a quarter after the operation, the stomach was partially torn from its connections by a fit of coughing, and passed into the abdomen; drawn out again, and fixed to the skin by Assalini's forceps. The part thus included be- came gangrenous, and when removed five days after the operation, the stomach was opened into. The sur- rounding adhesions were then firm. Through this fistulous opening, wine, beef-tea, milk, etc., were introduced, but they would not remain in the stomach.	Death ten days after the opera- tion.	Exhaustion. Peritonitis.	Sédillot, "Ga- zette des Hôp- itaux," p. 164. 1853; and op. supra cit., t. ii., p. 494.

6	1860	F.	41	Epithelial cancer, involving pharynx and larynx; complete obstruction of the esophagus, and consequent starvation.	Operation as described in text. Difficulty in securing the cardiac end of the stomach, as it was drawn downwards, and more to the left than usual by omental adhesion. Four ounces of blood lost during the operation.	Tube, with funnel fitted at the upper end, placed in the stomach through the wound, and retained there until the patient's death. No irritation produced by it. Milk and brandy in small quantities, with small doses of laudanum; nutritive enemata.	Death thirty-six hours after the operation.	Exhaustion. No peritonitis.	Sydney Jones, "Trans. Pathol. Soc.," vol. xi., p. 101.
7	1866	M.	57	Epithelial cancer of esophagus; passage all but completely occluded; patient sinking rapidly.	Ether spray used; operation as described in text. Scarcely any bleeding.	Subcutaneous injection of morphia; warm milk and water introduced into stomach, but caused much pain. Intensely acid, viscid fluid welled out from the stomach; milk and beef-tea given through catheter every half hour; great relief; nutrient enemata also administered; no vomiting. Patient gradually sank.	Death thirty-two hours after the operation.	Exhaustion. No peritonitis.	T. B. Curling, "London Hospital Reports," vol. iii., p. 218.
8	1866	M.	61	Epithelial cancer of esophagus, opposite upper border of sternum. Symptoms during five months; extreme dysphagia during ten weeks; liquid food returned, unless taken in very small quantity; the smallest bougie could not be passed.	Ether spray used; operation as described in text. Left lobe of liver exposed, under which the stomach fell, but was easily drawn forwards. Very little hemorrhage.	Subcutaneous injection of morphia; warm fomentations over abdomen; opening into stomach closed with oiled lint. Quarters of a pint of beef-tea or milk introduced through opening every two hours, alternately with egg and brandy; no pain; patient did well for some days, then symptoms of bronchopneumonia appeared.	Death on the thirteenth day after the operation.	Broncho-pneumonia. No peritonitis. The edges of the opening into the stomach firmly united to the abdominal parietes.	Sydney Jones, "Lancet," vol. ii., 1866, p. 685.

TABLE OF CASES.—Continued.

No.	Date.	Sex.	Age.	Nature of Stricture, etc.	Mode of Operation.	After-Treatment.	Result.	Cause of Death.	Operator and Authority.
9	1863	M.	70	Epithelial cancer of œsophagus, about three inches below cricoid. Symptoms increasing in severity during some months; starvation impending; smallest bougie would not pass.	Chloroform administered. No sickness produced; operation as described in text. Scarcely any hemorrhage.	Warm milk introduced into stomach through elastic tube; immediately rejected; a quantity of brownish-green fluid welled up through the opening. Morphine administered subcutaneously. Warm fomentations to abdomen; nutrient enemata of brandy, beef-tea, and arrowroot. Sank suddenly.	Death sixteen hours after the operation.	Exhaustion. No signs of peritonitis. Viscera generally healthy.	A. E. Durham, "Guy's Hospital Reports," series iii., vol. xiv., p. 185.

TABLE OF CASES

In which the Operation of Gastrostomy has been performed for the Removal of Foreign Bodies.

No.	Date.	Sex.	Age.	Nature of Foreign Body, etc.	Mode of Operation.	After-Treatment.	Result.	Operator and Authority.
1	1635	M.	.	Knife, six and a half inches in length. Retained about six weeks.	By straight incision through left hypochondrium, two fingers' breadth, under false ribs. Wound joined by five sutures.	Tents impregnated with tepid balsam, and a cataplasm of bolus earth, white of egg, and alum applied.	Wound healed on the fourteenth day after the operation.	Scioval, "Chellus's Surgery," Trans. by South, vol. ii., p. 391.
2	About 1743	F.		Knife swallowed eleven days previously. First three days no pain; then great suffering.	Incision through abdominal parietes on to knife, which could be felt projecting. The blade had penetrated the stomach, and caused		Rapid recovery.	Hubner, "Mém. de l'Académie royale de Chirurgie," 1743, t. i., p. 597. Quoted by Sedillot, op. cit., p. 401.

3		M.	Knife, nine inches in length, swallowed two months previously. Point could be felt towards left end of stomach.	Successful extraction.				Rapid recovery.	Florian Mathis. Recorded by Crolius. Quoted by Sédillot, p. 461.
4			Knife, ten inches long, swallowed six weeks previously. The knife first stuck in the œsophagus, but was forced or washed down into the stomach.	Incision in left hypochondrium. The stomach was hooked forward, and the knife, which could be felt, cut down upon and extracted.				Very rapid recovery.	Schwaben. Quoted by Sédillot, p. 462.
5	1819	F.	Silver fork swallowed eight months previously. During three months gave no pain; then the position being changed, caused much suffering; rapid wasting of patient. Fork could be felt through the parietes.	Incision through left rectus muscle. The peritoneal surfaces were adherent. Stomach opened, and fork extracted by forceps. No hemorrhage.				Rapid recovery.	Cayroche, "Bull. de la Faculté et de la Société de Médecine," 1819, t. vi., p. 447. Quoted by Sédillot, p. 457.
6	1823	M.	Silver teaspoon, swallowed some months previously. Could be felt as tumor through abdominal wall.	Swelling cut down upon, and something metallic felt; the opening into stomach was enlarged by bistoury, and the spoon extracted.				Rapid recovery.	Dr. L. . . . Quoted by Sédillot, op. cit., p. 456.
7	1854	M.	Bar of lead 10½ inches in length, 9 oz. in weight.	Chloroform given. Opening made into abdomen from second false rib to umbilicus. Stomach containing the bar grasped. Opening made and bar extracted.				Rapid recovery.	Dr. Bell, Iowa. "Boston Journal," vol. lxi., p. 480. Quoted in "Med. Times and Gaz.," 1860, p. 332.

devised for the same object, but in general, although the reduction may be perhaps readily effected, the difficulty consists in retaining the ends *in situ*. Respecting the suggestions for the use of a kind of cork-screw, to be screwed into the depressed portion, so as to draw it up, and for the employment of elevators and trepans, all these must be considered as not only useless, but the relics of the old cruel and barbarous surgery.

Longitudinal fractures of the sternum are very rare, so that their occurrence has been denied by many authors.

Two cases are mentioned by Plouquet,¹ and one by Barrau.² The latter case is quoted by Malgaigne, as follows: a mason, aged 60, fell from a scaffold on some large stones; the fracture was longitudinal, and the right portion depressed about eight to ten lines, the left somewhat overlapping: reduction was effected by drawing the arm to the side, and carrying it backwards, then pressing firmly on the middle of the right sternal ribs, making alternate movements from before backwards, so as to disengage the bones, whilst at the same time, gentle pressure was made on the left or riding portion, so as to keep it on its own level. After reduction, a compress was applied, and maintained by a firm bandage: the case was successful at the end of six weeks, and no deformity resulted.

Fracture of the sternum may be complicated with other injuries, as has already been partly alluded to. The most ordinary complication of this fracture is its occurrence in cases of fractured spine; but sometimes it may cause injury and inflammation of the pericardium, pleura, lungs, mediastinum, heart, etc. These complications will be alluded to in considering the injuries of those structures.

Dislocations of the ribs.—1. *Costo-vertebral*.—The anatomical arrangements for this important articulation would tend to prove that it would be almost impossible to luxate the head of the rib without fracture of the neighboring parts, so strong are the ligamentous tissues around. Yet it does appear notwithstanding that luxation has been effected after severe violence. However, in most instances, other complications have existed, generally fracture of the spine and displaced vertebrae. Platner observed that fracture rather than dislocation usually took place, and that the head of the rib could be only dislocated inwards, not easily upwards or downwards, and never outwards, in consequence of the transverse process. Boudet arrived at the same conclusion, as detailed in a memoir on the subject presented to the Académie de Chirurgie; the case of dislocation alluded

to by him, however, was clearly proved by Boyer (Mal. Chir., t. x., p. 123) to have been one of fracture of the rib near the spine.

Such cases are too few to make it necessary for me to offer many remarks upon the accident. The causes must necessarily be direct violence over a small amount of surface, so that it is expended upon one or two ribs, thus driving the heads forwards and inwards; the force may also be thrown upon the angle of the rib. The opposing forces must be powerful. The diagnosis is difficult, and must be only conjectural: thus there may be a deep depression, but this does not appear to be always present; and it may be overlooked, for there is great ecchymosis and swelling, with pain; there may be mobility of the rib without crepitation.

Table A, page 755, will elucidate the subject more fully.

The dislocation is generally discovered after death. In two of Kennedy's cases, Nos. 6 and 7, the patients recovered; in the boy, No. 7, the diagnosis was purely conjectural, and may be questioned altogether; and considerable doubts may be raised respecting the other case. However, taking into account the case of Sir A. Cooper, which was distinctly verified some years after, we may fairly accept Dr. Kennedy's case as one of dislocation.

2. *Costo-chondral dislocation* (Table B, page 757) is evidenced by the prominence of the rib in front of its corresponding cartilage. It is a question whether these are not cases of fracture. They are not of much importance, and require the same treatment, reduction and its maintenance, as for fractures.

3. *Chondro-sternal dislocation* (Table C, page 758).—Demarquay remarks that in the four cases there reported, it seemed to be rather a sinking in of the sternum, which had caused the luxation.

This luxation is accompanied with prominence of the cartilage and pain, and may be attended with severe after-symptoms, febrile excitement, and spitting of blood.

4. *Dislocation of cartilages upon each other* (Tables D, E, page 759).—It is a question whether these cases were not fractures. The sixth, seventh, and eighth ordinarily articulate with each other; sometimes the fifth and sixth, as also the eighth and ninth at times.

5. *Dislocation of the bones of the sternum*: the first piece dislocated from the second piece (Table F, page 760). Malgaigne divides these into traumatic and idiopathic luxations. Of the traumatic variety, he gives ten cases, all males, and occurring between the ages of eighteen and sixty. The causes were either direct or indirect; the direct causes were the rarest: the sternum receiving a violent blow, and great pressure

¹ The two cases of Plouquet are those of Krämer and Mayer.

² Barrau, Thèse de Strasbourg, 5 janvier, 1815.

TABLE A.—COSTO-VERTEBRAL DISLOCATION.

No.	Sex.	Age.	Cause.	Symptoms.	Result.	Post-mortem Examination.	Reference.
1	M.	Young.	Fell into a pit of clay.	Tumor of size of fist over twelfth dorsal spine. Paralysis of lower extremities.	Died fifteenth day.	Fracture of eleventh vertebra, and of twelfth rib on each side. Luxation of left eleventh rib.	Henkel, "Gaz. Méd.," 1834, p. 137.
2	M.	32	Fell ninety feet.	Immediate death.	Died.	Fourth left rib thrown forwards and inwards. Laceration of pleura and lung; no fracture of rib, but fracture of corresponding transverse process.	Boudet, "Bull. de la Soc. Anat.," 1839, p. 104.
3	M.		Part of a roof fell upon his back.	Fracture of spinous process of sixth and seventh dorsal vertebrae. Paralysis and other symptoms of spinal injury.	Died fifteenth day.	Fracture of sixth dorsal vertebra, and sixth, seventh, and eighth ribs on both sides. Two had their heads dislocated.	Alcock, "Lond. Med. Gaz.," 1839, p. 587.
4	M.	11	Blow from heavy lump of turf.	Tumor over heads of two or three last ribs. Paralysis and retention of urine. Suppuration ensued around seat of injury.	Died sixth day.	Complete dislocation of tenth rib forwards; and partial dislocation of the eleventh rib.	Kennedy, "Dub. Med. Press," 1841, vol. v., p. 30.
5	F.	15	Beams from roof of cottage fell upon her, one resting on her back.	Immediate death.	Died.	Dislocation of two last ribs on left side. Fractured skull, etc.	Kennedy, "Cooper's Dictionary," vol. i., p. 514.

COSTO-VERTEBRAL DISLOCATION.—Continued.

No.	Sex.	Age.	Cause.	Symptoms.	Result.	Post-mortem Examination.	Reference.
6	M.	20	Fall through scaffold, a portion falling on him.	Supposed dislocation of two last ribs on left side, downwards and forwards. Stated to have come back to natural position in three weeks.	Uncertain.		Kennedy, "Dub. Med. Press," 1841, vol. v., p. 30.
7	M.	17	Fall from top of high tree, striking back on one of projecting roots.	Indentation over two last ribs of right side. He rapidly recovered, and in ten days no depression was felt.	Uncertain.		Kennedy, "Dub. Med. Press," 1841, vol. v., p. 30.
8	M.		Several years before, was thrown off a horse across a gate, and was treated as for fractured ribs.	Lived some years, and died of fever.		Head of seventh rib thrown upon front part of corresponding vertebra, and there ankylosed.	Cooper, "Dislocations, etc.," edited by B. B. Cooper, p. 521.
9	M.	41	Fell from a third story, and lived five minutes after admission into hospital.		Died.	Left seventh rib completely dislocated forwards on to the vertebra without fracture. Fractured eighth, ninth, and tenth ribs, with injury to the lungs and diaphragm. Fractured lumbar vertebra. Fractured sternum, and other injuries.	"Post-mortem Records, Guy's Hospital," 1864, No. 178, Mr. Birkett.

TABLE B.—COSTO-CHONDRAL DISLOCATION.

No.	Sex.	Age.	Cause.	Symptoms.	Result.	Treatment, etc.	Reference.
1	M.	49	Attacked with fits of severe coughing.	Luxation of eighth rib, on left side, and of seventh rib on right. Accompanied with hernia of lung between eighth and ninth left ribs, and seventh and eighth right ribs.			Chaussier, "Bull. de la Faculté," 1814, p. 50.
2	M.		Thrown from donkey; the animal stepped on his chest—right side.	Separation of fourth rib, displaced backwards and downwards. Became replaced on deep inspiration.	C.	Bandage applied during inspiration, and perfect cure resulted.	Bouisson, "Cooper's Dictionary."
3	M.		Thrown from horse, striking chest against corner of mill-stone.	Luxation of fifth left rib, which was driven inwards.	C.	Replaced readily by strong dilatation of chest. Bandage. Recovery.	De Kimppe, "Annales de la Chir.," t. ix., p. 316.
4			Pressed between a post and a carriage.	The majority of the ribs luxated upon their cartilages.			Charles Bell, "Surg. Obs.," p. 171.

TABLE C.—CHONDRO-STERNAL DISLOCATION.

No.	Sex.	Age.	Cause.	Symptoms.	Result.	Treatment, etc.	Reference.
1	M.	Young.		Felt one of the luxated form.	G.	Replaced fingers, compens and bandages.	Sir C. Bell.
2	F.	72	Fell down during in- toxication.	Luxation of fourth left cartilage.	G.		Rayson.
3				Cartilages of fourth, fifth, and sixth true ribs luxated in front.	G.	Reduced by pillows behind back, and arching the spine.	Mannetti, 1790.
4				Luxation of a true rib in front of sternum.	Uncertain.		Monteggia.
5	Baker's boy.		Constant action of pectorals in knud- ing bread, and de- fective constitution.	Luxation of cartilages of fifth and sixth ribs.	Uncertain.	Advised to desist from em- ployment.	Cooper "On Disloca- tion," edited by R. B. Cooper, p. 467.

TABLE D.—LUXATION OF CARTILAGES ONE UPON THE OTHER.

No.	Sex.	Age.	Cause.	Symptoms.	Result.	Treatment, etc.	Reference.
1	M.	70	Fell backward off a chair, and tried to regain his position.	Painful cracking of chest. Swelling over three last true ribs of right side; elevation of ribs so that hand could be passed readily beneath them.			Martin de Bordeaux, "Journ. de Vandermonde," 1780, t. liv., p. 328.
2				Similar case under similar circumstances. Inferior cartilage luxated behind; sixth, seventh, and eighth ribs displaced.			Boyer.
3			Violent effort.	Seventh, eighth, and ninth ribs displaced from their articulation with each other.			Malgaigne, "Traité des Fract.," t. ii., p. 398.

TABLE E.—ENSIFORM CARTILAGE.

No.	Sex.	Age.	Cause.	Symptoms.	Result.	Treatment, etc.	Reference.
1	M.	18	Cartilage driven in by blow on epigastrium.	Frequent vomiting, continued until reduction was effected.	C.	Reduction by pressing the fingers beneath it, and elevating it into its place.	Martin, "Histoire de l'Acad. des Sciences," 1737, p. 48.
2	M.	19	Fell upon the seat of a boat, and struck his epigastrium.	Violent dyspnoea and vomiting, with pains in stomach; he was for twenty-five days unable to swallow fluids without rejecting. Death imminent.	C.	Incision made on one side of the depressed cartilage, extending through the peritoneum; an instrument passed beneath, and cartilage raised into its place. Immediate relief.	"Journ. Général de Méd.," t. xxii., p. 263, 1804.

TABLE F.—DISLOCATION OF THE BONES OF THE STERNUM.

1822	1823
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7	M.	60	Thrown into ditch, thirty feet, and fell against large stone.	At seat of union of first and second pieces, separation by fracture, and lower portion thrust under the upper.	D.	Lived eight days.	Maisonneuve, quoted from Sabatier.
8	M.	28	Fell fifty feet on to a wall, back being bent across it.	Separation of first and second pieces. Fracture of two last dorsal vertebrae and femur.	C.		Do. Case of Auran and David.
9	M.		Passing from one boat to another, fell and struck upper part of sternum against angular border of boat.	Dislocation of first and second pieces.			Malgaigne, "Case at Hôpit. St. Antoine."
10	M.		Indirect cause: was lying on side when enormous stone fell on chest, compressing it laterally.	Second piece projected in front of first, and with such force as to cause a wound.			Malgaigne, Duverney's case.
11	M.		Fell from first floor. Body flexed forwards.	Dislocation of first and second pieces with fracture of cartilage of left second rib.			Do. Chevaner's case.
12			Muscular action.	Separation, with fracture of sternum, first and second pieces.			Malgaigne.
13	M.	25	Not stated.	Second piece dislocated and thrown forwards on first. Fractured vertebrae.	D.	Lived two weeks, and died from effects of spinal injury.	"Post-mortem Records. Guy's Hosp.," 1827. Prep. Museum, 1043.70
14	M.	25	Struck on chest by a projecting part of an express train.	Dislocation of first and second pieces; the two first ribs remained attached to the upper portion. The lower part was thrown in front of the upper.	C.	Placed in a recumbent position with two bolsters under the back, and at the end of three days, bones resumed their natural position. Entire recovery.	Demarquay, "L'Union," 1868, No. 47.

TABLE G.—PATHOLOGICAL LUXATION OF BONES OF STERNUM.

No.	Sex.	Age.	Cause.	Symptoms.	Result.	Treatment, etc.	Reference.
1	M. Student in medicine.	23	Had pain in sternum, causing him to make constant pressure. Osteoscopic pains.	Disjunction of the first and second pieces ensued; a false movable joint formed, and subluxation.		Arthritic relaxation of joint—query, venereal? Anti-venereals gave no relief.	Bouché, "Journ. Clin. de Méd.," t. xxxiii., p. 287.
2	M. Mechanic.	Adult.	Employed in early youth at watch-making, and short-sighted; constant bending.	Gradual gliding of first piece in front of second subluxation.	C.	Readily reduced; could subluxate it voluntarily. Cured by avoiding the bending position.	Makaigne on "Dislocation," case of Martin.
3	M. Student.	19		Could touch backwards with the hand.		Difficult had nervous inflammation.	The Clinician, &c. to 188

Wounds of the parietes of the chest, commonly called non-penetrating wounds, include the several varieties of incised, punctured, lacerated, and gun-shot wounds; the general characters of which are described in the essays on WOUNDS and GUN-SHOT WOUNDS. Here we shall merely refer to certain special complications of the ordinary incised, punctured, and lacerated wounds, as they affect the surface and tissues of the chest. In the first place, the surgeon is always anxious to decide whether the wound be superficial or penetrating: are there any signs sufficiently well marked to indicate that the wound has not penetrated the chest? This question will be more appropriately considered when alluding to penetrating wounds, for it will be found that the only reliable signs are those of a negative character, viz., the absence of all the symptoms indicating a penetrating wound.

Wounds involving the skin and cellular tissue of the chest require no comment, otherwise than in the punctured variety; where there may be a long track traversed by the weapon, which may give rise to the formation of sinuses and local abscesses, and be difficult to manage in consequence of the movements of the upper extremity and the acts of respiration.

M. Vidal¹ remarks that punctured wounds, even of the slightest character, may be attended with symptoms simulating those of lesion of some internal organ or internal hemorrhage; such as coldness of the skin, feeble circulation, a sense of suffocation, syncope, and cough. These phenomena, he states, are chiefly observed in wounds received in duels. Whatever may be the courage of the champion, at the moment of combat the blood does not circulate normally, and the innervation is not regular, and he is not without emotion; if to this moral state there is superadded a wound of the chest, the wounded person regards it with most vivid uneasiness, and if fear has not already set in, it will soon take place. Thus is readily explained the occurrence of the above phenomena, and the salutary effect of removing these impressions by moral agencies of a reassuring kind.

Wounds of the muscles in front and behind the chest, when passing across their fibres, are attended with very great separation, and leave a large gap, in consequence of the power and extent of the individual muscle involved. And in the treatment of such wounds, the function of the divided muscle must be borne in mind, so that the edges may be approximated as closely as possible; thus, in wounds of the muscles in front of the chest, the arm must be drawn forwards, and carried inwards towards the opposite, and maintained in this position

during the healing of the wound: in wounds of the muscles behind, the opposite course is to be pursued. In a case of extensive wound of the latissimus dorsi muscle, and in a case of wound of the pectoralis major, M. Petit applied several points of suture, and with success; but sutures through muscular tissue are in general not advisable, unless there be a very large flap; and when employed, they should include the fascia in front of and behind the muscle, else the suture will tear away. Transverse wounds of the intercostal muscles weaken the chest, and sometimes permit the escape of the lung, to which we shall refer further on.

Wounds of the thoracic and other parietal vessels (excluding the intercostal and internal mammary) partake of the ordinary characters of wounded vessels: the only peculiarity in respect to the chest is in reference to punctured wounds, as in stabs by a sword, bayonet, foil, etc., where a vessel has been involved, and the blood, not being able to escape externally, has diffused itself under the muscles in the loose cellular tissue, and sometimes to a very great extent. This extravasation may coagulate and further effusion cease, when subsequent absorption ensues, with speedy recovery: on the other hand, it may excite inflammation, suppuration, and sloughing. Ice, or carefully applied compression, will be sufficient to arrest the hemorrhage, if not of very considerable extent; but where one of the larger trunks, such as the vessels of the axilla, has been injured, the case must be treated according to the rules laid down in the essay on WOUNDS OF ARTERIES.

Wounds involving the ribs, costal cartilages, or sternum, require immediate closure of the wound, or the ordinary treatment for fractured ribs. Here, however, we must be on our guard, and ascertain whether or not a portion of the weapon or instrument has been broken off and become imbedded in the rib, or cartilage; an event which has happened once or twice. In general the piece is loose, and readily removed, but in some instances it has been found fixed, requiring immense force to extract it; or it may be smooth and convex on its surface, such as a bullet, when difficulty is experienced in laying hold of it. Sometimes the pointed instrument may traverse the rib and appear on its inner side, causing a penetrating wound of the chest; this we shall refer to again.

Non-penetrating wounds may be attended with emphysema; thus, in wounds traversing the soft parts obliquely and gliding under the large muscles of the chest into the subjacent loose cellular tissue, the air from without may enter into the wound, being drawn in by the movements of the ribs; and this air, not being able again to

¹ Vidal de Cassis, *Traité de Pathologie externe*, tom. iv., p. 66.

It, however, sometimes leads to mischievous results, as liable to allow free ingress of air into the cavity.¹

The operation by means of the trocar and canula is the one usually recommended and adopted. By Mr. Edward Cock's permission we are enabled to make use of the following extracts from his excellent paper in the Guy's Hospital Reports, where the whole subject is fully discussed.

And, firstly, with respect to exploration previous to performing paracentesis. "Notwithstanding the perfection to which auscultatory diagnosis has been brought, and the exactness with which a practised ear is enabled to appreciate the deviations from natural structure and function within the thoracic cavity, the most experienced practitioner will sometimes be mistaken in his opinion, or, at any rate, puzzled by modifications of disease and conflicting evidence, which tend to obscure the clear signs of the presence of fluid. Under such circumstances it is always advisable, previously to tapping the chest, to explore the part in such a manner as shall, at any rate, inflict no injury on the patient, although its result may convince us of the inutility of a further operation. For this purpose, the grooved needle was invented and used; but, although applicable to many other purposes, it is at best a clumsy and inefficient instrument for exploring the chest, and frequently has left us as much in doubt after its withdrawal as previous to its introduction. The groove is so easily obstructed by the tissues through which the instrument passes, or by small particles of lymph, as to render the escape of fluid, which may really exist, a matter of great uncertainty. An instrument admirably adapted for exploration has been contrived by Dr. Babington. It consists of a needle contained in the smallest-sized canula; this is passed between the ribs into the suspected spot; the needle is withdrawn, and the escape of fluid from the tube at once indicates the existence and nature of the abnormal secretion. A further investigation, as to the size and direction of the cavity, may also be obtained by introducing a fine silver probe through the canula."

Secondly, with respect to the operation itself, Mr. Cock observes: "The trocar and canula which I have found best adapted for general use is about one-twelfth of an inch in diameter, and about two inches in length, exclusive of the handle. I prefer a circular to an oval instrument, as the former is more easily introduced, and does less injury to the intercostal muscles, whose fibres are perpendicular to the long diameter of the oval canula. The small canula has many advantages; its intro-

duction is easy, and attended with little friction; it gives but very slight pain, and it is calculated to elude the nerves and vessels; on its withdrawal, the opening which it has made becomes immediately and permanently closed, thus at once restoring the integrity of the cavity which has been entered; it is adapted to all ages, from the infant to the adult, and can hardly fail to find its way between the ribs, however narrow the intercostal space may be; again, it insures a slow and gradual evacuation of the fluid, and enables us to avoid the admission of air; at the same time allowing a better opportunity for the lungs to expand, and enables us more effectually to empty the cavity." Mr. Cock thus concludes: "It now only remains for me to describe the operation itself, which, as regards the pain it inflicts, is so trifling, that by avoiding all unnecessary display and preparation, the patient may be led to consider it as little more than the sequel of the discipline to which he is occasionally subjected when it is considered essential to make a thorough examination of his chest; the same position of the body being alike adapted for the one process as for the other. It will be found most convenient to let the patient sit *across* the bed, so as to admit of his body being readily lowered and supported over its edge. The spot having been determined upon, it is advisable to make a small puncture in the skin, just at the upper edge of the rib, with a narrow-bladed lancet; through which opening the exploring needle and subsequently the trocar may be inserted. This preliminary step is not absolutely necessary; but as the skin is by far the most impenetrable and resisting of the tissues to be traversed, its previous division will render the introduction and withdrawal of the canula more easy, less forcible, and attended with a minor degree of pain and alarm to the patient. The exploring needle having been first introduced and the presence of fluid ascertained, the trocar and canula may then be carried into the chest through the same track, giving the instrument a slight obliquity upwards, which will enable it to clear the edge of the rib. The depth to which the trocar must be passed will of course depend much on the thickness of the parietes, the presence of fat, muscle or œdema, for which due allowance should be made; and, in most instances, the penetration of the pleura will be appreciated by the sensation conveyed to the fingers of the operator, especially if the integument has been previously incised so as to diminish materially the friction.

"The remainder of the operation consists in getting rid of as much fluid as the strength and condition of the patient will bear, and carefully avoiding the admission of air into the cavity. On withdrawing the trocar, the fluid will at first be found to flow in a steady and equable stream, slightly augmented in force at each expiration. After the lapse of a shorter or a longer period, the flow will become checked at each inspiration, and then the body of the patient should be gently lowered into a horizontal posture, and turned slightly on to the affected side, so as to bring the cavity directly over the opening; and in this position he should be duly supported by assistants. The fluid will now recommence flowing in an uninterrupted stream; and when it again begins to flag, a still further quantity may be obtained, if the state of the patient permit it, by directing an assistant to make steady and con-

¹ M. Vidal (*Traité de Path. ext.*, 1871, tom. iv.), proposes a double operation: in the first instance, he makes an incision through the parietes to the pleura, and then allows the wound to be kept open until suppuration sets in, when he inserts a small fragment of caustic potash, so as to cause a slough, and thus evacuate the contents: this secondary operation may be performed by a bistoury or trocar instead of the caustic. He denominates it the operation "*en deux temps*."

reference must be made. But when the pericardium is alone involved, the wound will give rise to pericarditis; the symptoms, diagnosis, prognosis, and treatment of which must be learned from the standard medical works. Death need not be the immediate result of a wound of the pericardium, as proved by the case quoted by Sir A. Cooper, viz., that of a man who was wounded by a reaping-hook deeply through the cartilages of the ribs. The wound was small; the man had the appearance of one having sustained a dangerous injury, and in two or three days he complained of much pain in the region of the heart, and a quick, small pulse: he shortly began to swell, and could not lie down in bed; he lived for two or three weeks, and after death an effusion of bloody pus was found in the pericardium. Hennen relates a case, where there was a bayonet wound of the pericardium, and where the patient recovered from its immediate effects, but succumbed to pneumonia three months after. The heart, in this case, was found adherent by long fibrous bands to the pericardium.

For further references to wounds of the

pericardium, see the annexed table from Fischer.

[A case of rupture of the pericardium by a fall is recorded by Lewtas, in the *Indian Med. Gazette*, 1876-7, p. 296.]

Wounds of the heart are for the most part met with in gunshot wounds, but they may be seen in the other forms, namely, in the incised, punctured or lacerated varieties.

Some authors have divided them into penetrating and non-penetrating wounds, according as they involve the cavities or parietes of the heart; this subdivision is of little practical importance, for both are attended with equally fatal results; death taking place either immediately from hemorrhage or consecutively from acute pericarditis.

The following statistical table of 452 cases of wounds of the heart and pericardium are taken from Dr. Fischer's work,¹ which contains a very exhaustive article on the subject, comprising a short abstract and analysis of all the recorded cases.

¹ Dr. G. Fischer, *Ueber die Wunden des Herzens und des Herzbeutels*. *Archiv. f. klin. Clin. von Langenbeck*, 1868. Band ix., p. 571.

INJURIES OF THE CHEST.

[illegible]

FOREIGN BODIES IN HEART AND PERICARDIUM.

No.	Foreign Body	External Entrance.	Duration of Life	Situation in Heart.	Size and Shape of Foreign Body	Remarks.
1	Needle.	?	13 days.	Entirely in the wall of right ventricle	3 inches long.	Hypertrophied heart—pericarditis.
2	do.	St. rum.	6 years.	ditto.		Covered with lymph.
3	Ball.	Thorax.	20 years.	ditto.		Hypertrophied cicatrix.
4	Needle.	?	1 year.	Entirely in the wall of left ventricle.	2 inches long, broken and oxidized.	Encapsuled.
5	Paper wadding.	Thorax.	7 hours.	ditto.		Filled half the ventricular wall.
6	Ball.	Thorax.	12 days.	Entirely in the wall of septum ventr.	1 inch long.	Encapsuled—pericarditis.
7	Toothpick, ivory.	?	16 to 12 hours.	In the wall and cavity of right ventricle.	1½ inches.	
8	File.	Thorax.	21 days.	In the wall and cavity of left ventricle.	Broken off.	
9	Splinter of wood.		47 days.	ditto.		
10	Needle.	Thorax.	9 months.	In the wall and cavity of both ventricles.		Head in right and point ½ inch in left ventricle.
11	Iron stilet.	Thorax.	30 days.	ditto.	4 inches long, 2 lines thick.	right of
12	Needle.	Esophagus?	Long time.	In the wall and cavity of right ap. pendix.	1 inch long.	
13	Needle.	?	?	In the wall and cavity of left ventricle.	Rather more than 1 in. long.	Cicatrix in heart.
14	Ball.	Thorax.	Some years.	In the cavity of right ventricle.	Flattened.	Fell out of pulm. artery. in
15	Ball.	Thorax.	6 years.	ditto.	do.	Encapsuled—cicatrix in heart.
16	Ball.	Thorax.	67 days.	ditto.		Free hypertrophied cicatrix.
17	Shot.	Thorax.	5 weeks.	ditto.	3 inches long.	Shot through lung, vena cava, etc.
18	Wooden peg.	Thorax.	23 days.	ditto.	4 lines long.	Free, covered with fibrin, in several places.
19	Hair wadding.	Thorax.	1½ years.	ditto.	1½ inches long.	Death from gangrene of lung.
20	Thorn.	Esophagus.	8 days.	ditto.	Long.	No external wound.
21	Bone.	Esophagus?		In the cavity of left ventricle.	Long.	
22	Needle.	Esophagus.		ditto.	Long.	
23	Needle.	Esophagus?				

DEATHS NOT IMMEDIATE.

Cases. No.	Time.	Punctured wound.	Incised wound.	Gunshot wound.	Ruptured.
37	1 hour	5	26	3	3
46	From 1 to 24 hours	5	25	8	8
74	1 day to 1 week	7	60	6	1
40	2d week	2	31	2	5
8	3d week	4	3	1	...
3	4th week	...	2	1	...
1	5th week	...	...	1	...
2	7th week	1	...	1	...
1	10th week	...	...	1	...
2	2 months	...	1	1	...
1	6 months	...	...	...	1
4	9 months	1	3	...	...
57	Uncertain	4	15	15	23

LONGEST DURATION OF LIFE.

	Punctured wound.	Incised wound.	Gunshot wound.	Rupture.
Right ventricle, . . .	18 days	18 days	2 months 6 days	12 days
Left " . . .	21 days	9 weeks	10 weeks	8 days
Both ventricles, . . .	8½ months	5 days	....	1½ hours
Right auricle, . . .	Long time	15 days	....	14 hours
Left " . . .	2 days	2½ hours	....	2 days
Septum ventriculorum, . . .	10 days	12 days	12 days	4 hours
Apex, . . .	1 day	20 days	7 days	9 hours
Base, . . .	....	....	7 days	....
Coronary artery, . . .	8 days	....	....	....
Pericardium, . . .	2 or 3 weeks	Several days	2 days	8 days

For reference to these cases, see Fischer, *op. cit.*

The duration of life does not bear any proportion to the extent of the wound; thus, in the well-known case quoted in most French works of the celebrated first grenadier of France, who received a lance-wound between the sixth and seventh ribs, which implicated the anterior parietes of the left ventricle of the heart, it caused immediate death; and on examination half an hour afterwards, the pericardium presented a rent of four to five centimètres, and contained but little blood; the wound in the heart was very small and very superficial. Again, in the year 1728, one of the ladies of the Sardinian court ran a long gold needle into the chest of her husband, whilst asleep, and caused his sudden death; on examination, the right ventricle was found pierced through and through. The thinness of the parietes of the auricles is not the cause of a more rapid death; thus in the case of the Duc de Berri, whose right auricle was traversed by a saddler's awl, he lived eight hours;¹ and in the case quoted

by Blagny,¹ where the right auricle was wounded, the patient survived five days.

The direction in which the wound is made will materially affect the duration of life; thus, if made in the course of the muscular fibres, there may be little or no hemorrhage; but if the heart is cut across, the edges will separate to a great extent, and sudden death occur from the immediate gush of blood.

The following recorded cases are instances of long survival after wounds of the heart. Breschet² quotes the case of a man who was thrust against a wall by the shaft of a cart, causing fracture of the sternum and of the fourth, fifth, and sixth ribs, and laceration of the pericardium, with superficial lesion of the left ventricle to the depth of one-third of its substance; he lived twelve days: on examination, there was no fluid in the pericardium, but a

considérations cliniques sur ses blessures; son autopsie;" *Paris Médicale*, vol. xxvi., 1879, 17, 33.]

¹ *Journal de Médecine*, an xl.

² Breschet, J., *Répertoire d'Anatomie et de Physiologie*, 1826, tom. ii.

[¹ A. Corlicu, "L'Assassinat du Duc de Berri;

pain in the chest, and dyspnoea, with a feeling of compression of the heart; after four days he went to work, but soon after had violent fever, oppression, and delirium, with insomnia, extreme thirst, and frequent syncope. He died on the eleventh day. The pericardium was full of sanious pus, and the parietes of the auricles, here and there, ulcerated and softened.

Sixthly, contusion of the chest may be complicated with injury to the heart, causing a rupture of its fibres or its valves. The symptoms and prognosis will be the same as those detailed in WOUNDS OF THE HEART. Death, however, in these cases, is almost always instantaneous, although some have lived for several hours. There is a preparation of a lacerated heart of a child in the Museum of the Royal College of Surgeons, Edinburgh;¹ in the description of which it is stated that a cartwheel had passed over the chest and occasioned instant death, but there was no external wound or fracture of the ribs. Dr. Chris-

tison¹ mentions two cases from violence, the one caused by a fall, the other owing to a blow. Mr. Gamgee² has collected 27 published cases of the kind; 12 occurred on the right side, of which 8 had rupture of the ventricle, and 4 of the auricle; 10 occurred on the left side, of which 3 were of the ventricle, and 7 of the auricle. In half of the cases the pericardium was intact.

[In 1875, I reported to the Pathol. Society of Philadelphia a case of triple rupture of the heart, in a man struck by the locomotive of an express train. He was carried along in front of it for some forty feet, and then fell over on the other track, sustaining various injuries; was dead when picked up. One rupture was in the posterior wall of each auricle, the third in the inter-auricular septum. Trans., vol. vi., p. 59.—P.]

For further information see Fischer's work on the subject.

¹ Watson On Homicide, p. 96.

² Researches in Pathological Anatomy and Clinical Surgery, 1856.

¹ See Trans. Edin. Med.-Chir. Soc., vol. i.

INJURIES OF THE BACK.

BY ALEXANDER SHAW, ESQ.

Revised by CHAS. T. HUNTER, A.M., M.D.

PROVISIONS IN THE STRUCTURE OF SPINE AGAINST COMMON INJURIES.

ACCIDENTS to the vertebral column derive their chief importance from endangering the spinal cord. It may assist in enabling us to estimate the comparative liability of different parts of the spine to be injured, and the relative severity of the effects in the various kinds of violence to which it is exposed, if we take a general survey of its structure and uses, before entering on the proper subject of this essay.

The spine serves several distinct offices in the skeleton; some of which appear, at first, incompatible with others. It is a pillar for sustaining weight, a girder for

connecting distant members, an elastic-jointed mechanism for motion, a supporter of the ribs for breathing, and a tube for containing the most vitally important organ next to the brain, the medulla spinalis. The safety of the spinal cord is secured in various ways. Being lodged in the centre of the column, it occupies neutral ground in respect to forces which might cause fracture. For it is a law of mechanics that when a beam, as of timber, is exposed to breakage, and the force does not exceed the limits of the strength of the material, one division resists compression, another laceration of its particles, while the third, between the two, is in a negative condition. Applying this principle to the vertebral column, it will presently be seen that the

swelling has been dispersed, and induration remains, mercurial liniment or tincture of iodine may be advantageously used. It will be proper to provide the patient, when about to leave his bed, with a riding belt stiffened by additional whalebone.

Hæmaturia, from sprain.—In cases of sprain occurring at the lumbar region, it is not uncommon for the patient to pass blood with the urine for several days after the accident. From this it may be inferred that one, or perhaps both kidneys have been injured, so that a breach of surface has been produced. When the situation of these glands in relation to the spine is considered, it need not surprise us that a complication such as hæmaturia should be met with. The kidneys lie in close contiguity to the spine at the part where the flexion of the column, on the occasion of sprain taking place, is most acute. And they are fixed to the place they occupy with comparative firmness: so as to be incapable, like the floating viscera, of evading injury. It is also to be borne in mind that, when the spine is violently bent, in the production of sprain, the flexion, at the moment, is much greater than observation could enable us to discern; for owing to the elasticity of the column, it follows that, as soon as the compressing force ceases to act, it recovers its form, by its resilience. The writer cannot refer to the evidence of post-mortem examinations for stating at what particular part of the gland the lesion from which the blood is derived is situated; but it may be conjectured that it is somewhere in the hilum. In that case, the blood will flow directly into the pelvis, and thence, along the ureter, into the bladder. The amount lost varies in different cases. Clots are occasionally formed in the bladder, requiring the injection of warm water for breaking them down. In general, the discoloration of the urine is high—deep red, or brown—only for one or two days; on the third or fourth day, the color may be clear and florid; and in a day or two more, or even in a shorter time, the water may be of its natural appearance.

Rarely is the quantity of blood lost so great as to excite alarm; yet in a case lately witnessed by the writer, apprehensions were for some days felt that the patient, a young man, would not recover. The sprain had not been severe: the bleeding was uninterrupted, and unusually profuse during the first four days; it nearly ceased for two days; then it returned, and lasted with its former profusion for two days. A cessation for a day now took place; on the following day, the tenth, it reappeared in great quantity; but it then stopped finally, the patient having become blanched and excessively weak.

When such an important gland as the kidney has been crushed and broken, to such

an extent that hemorrhage goes on from a rent in it for several days, it might be thought probable that the damage would be followed by ulterior bad results, especially that inflammation—nephritis—would ensue. But extensive observation negatives that view: general experience shows that when patients recover from the immediate effects of hæmaturia brought on by sprain of the spine, they are not more prone than others to renal complaints.¹

It is here to be remarked that, if the kidneys be previously diseased, hæmaturia may occur from a comparatively slight injury. That is well known in reference to cases in which calculi have formed in the kidneys. The remark applies also to the congested condition of the gland in the early stage of albuminuria, of which the following case is an illustration.

The writer was witness in a trial in which a gentleman claimed compensation from a railway company, for being affected with Bright's disease, in consequence of an injury to his back received in a collision on their line. The injury consisted in a bruise over the right ilium, and side of the loins. As he walked some distance for his pleasure, and took a long journey immediately afterwards, it may be inferred that the contusion was not severe. On the following day, he observed blood mixed with his urine; and he continued for four more days to pass blood. On examining the urine at that time, his medical attendants found albumen contained in it; and they particularly stated, that the quantity of albumen was larger in proportion than could be accounted for by the presence of the blood. During the whole period from the date of the accident to that of the trial, eleven months, the urine was found to contain albumen. And the view contended for by the witnesses in his favor was—that albuminuria had been caused by injury inflicted on the right kidney, in the collision. On the part of the railway company, it was ascertained that previously to the accident the gentleman had been subject to eczema; and that, shortly before it, he had been cured under treatment. Accordingly, the medical witnesses on that side (the writer being one) argued that albuminuria was known to follow eczema, on its being cured; and for that, and other reasons which need not be stated, they expressed a strong opinion that the plaintiff was suffering from the disease when he met with the accident, and that the injury could not have brought it on. The jury, nevertheless, awarded heavy damages to the sufferer.²

¹ In his Lectures delivered at the College of Surgeons, Mr. Le Gros Clark makes the following remark, regarding hæmaturia, as it occurs in connection with injuries of the spine: "Of the many cases I have witnessed, I have never had reason to suspect that nephritis or organic disease followed." Brit. Med. Jour., October 3, 1868.

² A somewhat similar case was reported briefly in the Times. A woman had been bruised in the loins, from the falling in of the roof of her dwelling. She claimed compensation for the injury, from her landlord. The

nal canal, pus was found to have dropped down through the whole length of the sheath, to the cauda equina. Outside the spine, pus lay under the scapula; in front, it was bounded by the oesophagus.¹

Mr. Simon has furnished a case which illustrates the second form of the injury. It is given under the title, "Latent Fracture of the Spine proving fatal by Suppuration within the Vertebral Canal." The details are briefly these. A girl, in the dark, fell down an embankment, twelve feet high, and injured her neck. She afterwards walked three miles. For eleven days she continued at her occupation. On the fifteenth, she applied for admission into St. Thomas's Hospital, on account of severe pain in her neck. No irregularity in the spine could be detected. There was no anaesthesia or paralysis. Her complaints of pain and tenderness were vague; she spoke chiefly of suffering between the shoulders; and turning round into the prone position in bed was done slowly, stiffly, and with cries. Early on the following day she complained of numbness and twitching in her limbs, especially in the lower; and in the evening, voluntary motion was quite lost in the legs, and almost in the arms; sensation also was very much impaired in both. High fever, with delirium and tympanic distension of the abdomen, accompanied the last-mentioned symptoms. She died on the third day after admission, or eighteenth after the fall.

"On examination thirty hours after death, a horizontal line of fracture was found traversing the body of the seventh cervical vertebra, just above its inferior surface. Beyond a very little gaping in front, which would allow the edge of a scalpel to be insinuated flatly between the fragments, there was not the slightest displacement; and the posterior common ligament was unbroken. The vertebral canal contained between its osseous walls and the dura mater a large quantity of pus, which, from two inches below the foramen magnum, descended the whole length of the cord. At the several intervertebral holes, it had crept somewhat along the issuing nerve-sheaths, and between the first and second dorsal vertebra had actually emerged, following the subdivision of the first dorsal nerve, so as to spread among exterior parts. These burrowings of matter were cut into before the canal was opened. . . . The outer surface of the dura mater was roughened by inflammatory deposits; but none were found within it; nor was there any softening, or microscopical change in the structure of the spinal cord. No other disease was discovered in the body."²

Concussion of the spinal cord.—High authority sanctions the use of the term

¹ Surgical Observations, p. 145.

² Trans. Pathol. Soc., vol. vi., p. 42.

Further on, a case will be noticed in which the atlas has been fractured transversely near its middle, and in which the anterior segment, including the articular surfaces in relation to the occiput and the atlas, and carrying off with it the processus dentatus of the axis, had been dislocated extensively forward; no suppuration, and no paralysis followed; the patient lived about a twelvemonth. During life, the nature of the injury was unsuspected; it might well have been taken for sprain.

"concussion" of the spinal cord, to indicate an injury of the back, followed by paraplegia.¹

The word is intended to express a certain effect produced upon the cord by violence, which reaches it directly. The injuries that have hitherto engaged our attention have arrived at the cord indirectly; that is, the functions have been destroyed or impaired through injuries which have originated in structures adjoining, but external to, the spinal sheath. In concussion, the inmost recess is penetrated at once, and the organic changes connected with the cord commence and finish within the sheath. That sheath, continuous with the cerebral dura mater, forms along with it the boundary of the large cavity that contains both brain and spinal cord. Accordingly, there is this difference between the first class of injuries and concussion, namely: that in the former the sheath or dura mater of the spine forms a defensive barrier, more or less effectual, between the primarily-injured structures and the cavity common to the brain and cord; while in concussion, the morbid processes are conducted from first to last in the interior of that cavity.

The term "concussion," as applied to the spinal cord, has obviously been derived from a supposed analogy between the injuries occurring to it and to its kindred organ the brain. When a man's skull is beaten in and a fragment is depressed, or when a torn artery throws out blood which coagulates and produces pressure on the brain, paralysis of one side of the body ensues; the surgeon elevates the depressed fragment, or exposes and washes away the coagulum, and forthwith, in favorable cases, the paralysis disappears. So when the spine is fractured, and displacement of the fragments takes place, the end of one of the portions presses upon the cord, and it is conceived that the paraplegia resulting from the accident must be owing to that compression. But certain cases of injury of the back are met with in which paraplegia has directly or shortly afterwards occurred, and in which, upon examination of the spine after death, no fracture, displacement, extravasated blood, or anything capable of compressing the cord, can be discovered. The explanation therefore given is, that the spinal cord had been damaged by concussion.

The following case has been just recently reported in one of the journals.

A man fell from a railway van, and lighted

¹ Treatise on Dislocations and Fractures, by Sir A. Cooper; edited by Mr. B. Cooper, p. 526.

"Concussion of the spine," often used, is objectionable as a title. We do not speak of the concussion of the skull.

it will be perceived that the number of cases in which patients have recovered the power over their limbs and sensation, when these have been lost from fracture at this part, is much greater than in any other.¹

Fracture in the dorsal region, between the tenth and fourth vertebrae.—Owing to the small size of the cord at the part here denoted, it is liable to be crushed through its whole thickness, when the spine is broken anywhere in its course. Complete paraplegia may therefore be anticipated: the lower extremities will be deprived of motion and sensation; the bladder and rectum will be paralyzed, and the patient be exposed to have extensive sloughs on his back. Respiration will be imperfect, but not to such a degree as of itself to imperil life. From the diaphragm and upper third of the thorax continuing to perform their functions, inspiration will be accomplished with considerable force. But, owing to the paralysis of the abdominal muscles, the act of expiration will be feeble; yet it will be effected—first, through the elasticity of the walls of the chest, which will descend and collapse with a certain impulse, at the end of each inspiration; and, secondly, through the resilience of the abdominal viscera. If the patient should have had fracture of one or more ribs in connection with that of the spine, or, before the accident, had been subject to chronic bronchitis, the dyspnoea will be dangerously aggravated. If the patient's life be prolonged till union of the fracture has been effected, the probability of his surviving, although with paralysis

remaining, is much increased. And some circumstances favor the procuring of union, in cases of fracture about midway in the dorsal region. First, owing to the rigidity of the column at this part, the displacement of the fragments is not commonly so great as elsewhere. Secondly, from the ribs acting on each side like splints, and the extensive overlapping of the processes of the vertebrae, the broken surfaces are kept in apposition and at rest. Should union be obtained, an important advantage will be gained, especially in regard to the healing of the bed-sores. The large sloughing sores, with profuse discharge, which form over the sacrum and adjoining prominent bones, with formidable rapidity, in cases of fracture of the spine, are known to be frequent causes of their fatal termination. And that which principally gives rise to these sores and prevents their healing, is the constant pressure to which they are subject, from the inability of the patient to change his position, and the irritation produced by his lying unconsciously for long periods on parts of the bed wet and soiled from the urine and feces passed involuntarily. The chief difficulty met with in endeavoring to avert these evils proceeds from the breach of continuity in the spine, considered as the beam that ties the upper to the lower divisions of the body. It is obvious that, owing to the loosening of the connection between the superior and inferior portions of the column, at the seat of fracture, a movement of the pelvis and lower extremities will not be accompanied with a corresponding movement of the trunk above, but that the lower fragment of the spine will rotate on its axis, while the higher will remain stationary. Whatever care, therefore, be taken by intelligent nurses, in turning the patient successively on different sides, to protect the sores from pressure—however attentive they may be, in moving one division of the body, to make the other move along with it—a great deal of friction between the opposing broken surfaces will be produced, most prejudicial to union, and the source of irritation to the system. But if the patient should live sufficiently long for the ends of the fragments to be knit together, even although it be only by fibrous connections at first, and more especially by ossific matter, the obstacles referred to will be removed. It will be practicable and safe to keep him lying on each side alternately, and the sores will immediately put on a healing aspect.

Fracture in the cervico-dorsal region.—This part of the column, it has been already stated, being the point of junction between a flexible and inflexible portion of the spine, is peculiarly liable to fracture. It is understood to comprise within its lim-

¹ A series of five cases of recovery from paraplegia, caused by fracture of the spine in the dorsi-lumbar and lower lumbar regions, all occurring within a short period of each other, has been recently published in the third volume of the London Hospital Reports. The titles of the cases are subjoined:

"Fracture of the Spine in the lower lumbar region, with displacement—Paraplegia, with Paralysis of the Sphincters—Gradual improvement—Recovery in four months," p. 326.

"Fracture of the first Lumbar Vertebra with slight displacement—Incomplete Paraplegia at first—becoming more complete two or three days afterwards—Nearly complete Paraplegia for a fortnight—Gradual improvement—Perfect recovery," p. 327.

"Fracture of Spine, with displacement, in lumbar region—Paralysis of lower extremities, bladder, and bowels—Recovery in three months—Power of walking regained; but certain parts of the integuments of feet and nates still quite without sensation," p. 332.

"Fracture of Vertebra, with displacement in upper lumbar region—Paralysis of motion and sensation in the lower extremities—Retention of urine and feces—No priapism—Recovery in six months," p. 335.

"Fracture, with displacement, in the mid-lumbar region—Symptoms of spinal injury not recognized at first—Incomplete Paralysis of lower extremities—Recovery," p. 346.

notwithstanding the loudness of the report, the murdered man never stirred a limb, but seemed to continue his sleep undisturbed.

The same Museum contains a remarkable specimen of dislocation of the greater part of the atlas, including the articulating processes, both from the occiput and from the axis, with fracture of the odontoid process; followed by solid union of the displaced fragments. The patient, a farm laborer, had been under the care of Mr. B. Phillips. He had fallen headlong from a hay-rick; had been stunned for a short time, but then walked to the house of his medical man. He resumed his occupation in two days. A month after the accident he walked two miles to Mr. Phillips's house, and complained only of a stiffness of the neck, which prevented him from turning his head. There was a swelling in the throat, supposed to be enlargement of the tonsils: his speech was thick, and he had some difficulty in swallowing. He lived for a twelvemonth after the accident, his death being caused by general dropsy. The specimen shows the odontoid process of the axis to have been broken at its base, and the atlas fractured across at the thin parts of its arch, behind the articulating processes. The anterior segment of the atlas, consisting of the articulating and transverse processes, with the arch in front for receiving the odontoid process, had been displaced from its situation between the occiput and atlas, and transported to the forepart of the body of the axis. The broken ends of the segment, behind the articulating processes, had become firmly united to the sides of the body of the axis, against which they abutted. Thus a ring had been formed before the axis, on the same horizontal plane; and as it had some resemblance to the foramen containing the spinal cord, the specimen had the singular appearance of being a single vertebra provided with foramina for two vertebral canals.

The mode in which the displacements shown in the specimen were produced, appears to have been as follows. The fracture of the odontoid process of the axis and that of the posterior arch of the atlas probably took place first. Now these fractures would have the effect of removing the chief impediments to the segment of the atlas situated between the occiput and axis being thrown forward out of its place. Next, as the patient fell from the hay-rick head foremost, it may be inferred that, when he came to the ground, a powerful force would be directed on the cervical vertebra in such a way as to compress the segment of the atlas on its upper and under articulating surfaces, and cause it to be shot, wedge-like, horizontally forward, and to be thrown over the edge of the axis, to lie between that bone and the pharynx. When the atlas had thus vacated its place, the condyloid processes of the occiput would settle down on the axis; and they would rest on it with comparatively greater security, owing to the odontoid process having been broken off. In course of time, new joints would be established between the occiput and axis.

It is much to be wondered at that an injury of such great severity as must have been inflicted to produce the effects exhibited in the specimen, especially considering its situation in reference to the spinal cord, should not have caused the instantaneous death of the patient. The only thing that can be noted in the way

of explanation appears to be, that, from the theca near the seat of injury, namely, at the foramen magnum, being closely adherent to the vertebral canal, and from its being likewise thicker and firmer opposite to the atlas than lower down, that strength and stiffness of the membrane may have had some share in protecting the cord from being crushed, when the displacement took place.¹

Of bed-sores.—It has just been seen that when the spine is fractured high in the column, the chief danger to life is that caused by interruption to the breathing. But in whatever part it be broken, and however low, if paraplegia has been produced, the patient will be subject to the exhausting effects of sloughs and bed-sores.

The common situations for these sores are—1. The skin over the most prominent part of the convexity of the sacrum; 2. That over the tuberosities of the ossa ischii; 3. The skin over the greater trochanters of the thigh-bones.

The time varies at which the sloughs begin to form after the accident. Equal care being supposed to be taken in all to avert them, the differences may depend on the age, constitution, and bulk of the patients. They generally manifest themselves about the fourth day; but they have been observed as early as the second. The first sign of a slough beginning is that the skin presents a white, sodden appearance; it then becomes brown and mottled, and the cuticle separates. In a short time, a patch in the centre turns black; the skin is then disintegrated, and ere long becomes pulpy and shreddy. The sloughing extends from the circumference indefinitely. If it stop anywhere, a line of demarcation will be observed. In some cases the destructive process is carried so deeply as to involve the muscles. After the slough has become detached, it is not uncommon to find the part of the sacrum over which it was formed in a necrosed condition. The vertebral canal has been opened in such circumstances, causing inflammation to spread to the membranes of the cord.

A remarkable feature in the character of these sloughs is the rapidity with which they form and extend; and that even in persons not debilitated by previous illness, but shortly before in robust health. That observation has induced some to believe that the chief cause of the production of sloughs, in cases of paraplegia from fracture of the spine, was a supposed defect of nervous influence, due to the destruction of the spinal cord. But, before accepting that as the only explanation, the peculiar

¹ For Mr. B. Phillips's account of the case, see *Med.-Chir. Trans.*, vol. xx., p. 78. That gentleman presented the specimen to Sir Charles Bell.

which concur, individually and collectively, to resist the effects of external violence. However, whilst the bones constitute a means of protection for the contents of the cavity, they sometimes become the secondary agents in the infliction of considerable mischief, for fatal injuries are sometimes produced by their fragments perforating the pelvic viscera.

The arrangement of the subject is as follows:

I. Contusions involving the soft parts in contact with the outside of the pelvis.

II. Fractures and dislocations of the bones forming the pelvis.

III. Injuries of those organs in relation with the pelvis which are connected with the functions,

A, of Micturition;

B, of Generation, male and female;

C, of Defecation.

I. *Contusion* of the soft parts covering some portion of the pelvic bones is of frequent occurrence. Thus, a railway laborer often receives a squeeze between the buffers of two railway carriages. The result is more or less bruising of the soft tissues, and the laceration of smaller or larger blood-vessels, which, in some instances, gives rise to a large extravasation of blood. I have seen nearly the whole of the integuments detached from the external surface of the glutei muscles and fascia, without any sign of a scratch on the skin. Blood had been effused into this pouch, and a large swelling was the result. Around the swelling, ecchymosis appeared a few days after the infliction of the injury. After repose and the local application of stimulating lotions, the blood became absorbed. Large swellings, the result of the effusion of blood, occasionally arise after kicks from a man or beast, the soft parts being well placed, between the iron boot-toe or shoe and the dorsum of the ilium, to receive the full influence of such force. In these injuries, the blood is extravasated beneath the gluteal fascia, and forms a circumscribed swelling, over which the fluctuation of its fluid contents is distinctly perceptible. Ecchymosis does not appear around the swelling, even after the lapse of several days from the receipt of the injury. Under these circumstances the collection of blood might be mistaken for an abscess, if the history of the case be not carefully ascertained. The nature of the swelling may be diagnosticated, however, by learning that it appeared soon after the receipt of a blow; that no pain, before the kick was received, preceded its formation; and that its development had not been attended with any constitutional disturbance.

Contusions of an apparently trifling nature,

at first sight, may yet be attended with appalling results. Thus, a delicate, strumous, badly-nourished boy receives a blow on the pelvic region, as a kick, whilst at play, the primary effects being merely local tenderness or stiffness. But in a few days intense constitutional disturbance may arise, and death ensue from disease of the membranes of the spinal cord.

II. DISLOCATIONS AND FRACTURES OF THE BONES FORMING THE PELVIS.

Injuries of the pelvic bones and joints are usually severe. They are attended with more or less risk to life, which does not ensue solely from the damage done to the bones themselves, but arises from the contents of the region being involved in the mischief.

It would be idle to write a systematic description of the dislocations and fractures of each pelvic bone separately, since fracture and dislocation occur so frequently in combination, and as the effect of the same amount of violence inflicted on the patient. Indeed, as the pelvic bones are united together by interarticular fibro-cartilage, as well as ligaments, a solution of continuity between their articulating surfaces differs widely from the displacement of the articular extremities of the long bones which compose diarthrodial joints. Hence it happens that very great violence is required to sever the union between the pelvic bones, and the same degree of force may produce a solution of continuity of the osseous texture in preference. Even in those cases in which the greatest amount of dislocation is effected, as, for example, of the os innominatum from the sacrum, the borders or edges of the articular surfaces of either one bone or the other, or even of both bones, are frequently broken off. This fact, incontestably demonstrated by preparations in every anatomical museum, renders it extremely difficult to decide during life whether the case be one of fracture simply or a combination of the two injuries. The only movable articulation, to be noticed in this essay, in which articular cartilage and a synovial capsule exist, is that between the sacrum and coccyx; and to a description of the dislocation of the latter bone a few lines will be devoted.

The massive strength of the pelvic bones of the adult skeleton and the capability of resisting violence enjoyed by the tissues which unite them together, combine to neutralize the effects of the application of ordinary force, which in bones constituted with less strength would give rise to a solution of continuity in the osseous texture. Extensive fractures are, however, occasionally repaired. There is a pelvis in the Museum of the Royal College of Sur-

there. Will an anatomist believe that a ruptured bladder can contain "between five and six pints" of urine, or a physiologist that this quantity would be secreted in about forty hours, whilst the patient was suffering from peritonitis, the result of extravasation of urine into the peritoneal cavity? The inference, with the majority of readers, would be, that the catheter had passed through the rent in the viscus, and removed the serous effusion together with the extravasated urine from the peritoneum. The chief point, therefore, with the surgeon must be to maintain the contracted state of the bladder, because in this condition the edges of the rent remain in close approximation. And for another reason too. In a hollow viscus, constructed as the urinary bladder, the mucous membrane holds a somewhat variable position to the other tissues of which the organ is composed. The loose attachments of this membrane admit of a variation in its relations to that tissue with which it is in immediate connection, during the opposite conditions of extreme distension and contraction. So that when all the coats are torn through, in a line perfectly corresponding at the moment of extreme repletion, the non-contractile mucous coat might overlie the aperture in the other tunics, when the viscus is empty, and thus form a plug or valve to assist in preventing the further escape of urine through the laceration. And furthermore, the rent would assume very different proportions or dimensions in a dilated and a contracted state of the organ.

In order, therefore, to guard the patient against any injury which may arise from the catheter being pushed through the lacerated opening in the bladder, a large flexible instrument should be used, which has an opening at the extreme point, and not at the sides near the end, as the catheter in ordinary use has. The flow of half an ounce of urine, or even less, through such an instrument is sufficient to satisfy the operator that the bladder contains no more. The surgeon must satisfy himself upon physiological principles regarding the quantity of urine drawn off, and not calculate upon a very abundant secretion. Should the catheter be secured in the urethra? If its point could be fixed just within the orifice of the bladder, the urine as secreted would drop from the open end, and all danger of its entering the peritoneal cavity would be thus avoided. But if there be any risk of introducing it too far, or of leaving it even in the rent, it is clear that the repeated introduction of the instrument is preferable. A reply to this query must then, I think, be submitted to the judgment of the surgeon. The patient must not, on any account, be allowed to make a voluntary effort to micturate; and the use

of the catheter should be persisted in for *not less* than fourteen days after the receipt of the injury.

It should be here stated that many surgeons doubt the possibility of recovery after rupture of the bladder and its peritoneal covering, that is to say, after extravasation of urine into the peritoneal cavity. Readers interested in this subject may refer to the controversy between Dr. Elen Watson¹ and Dr. Gillespie² on Mr. Chaldecott's case. A paper on this injury by Dr. Harrison³ is of great interest. Recently, Dr. Thorp⁴ has published a case "in which the peritoneal sac was washed out with tepid water injected through the rent in the organ," ending in recovery! It is to be much regretted that only the local symptoms of the injury are fully detailed. We vainly search in the account of the first two days after the injury for those constitutional symptoms of extravasation of urine into the peritoneum which are so constantly present after that occurrence. This omission is most unfortunate, after the introductory observations which precede the recital of the case.

The urinary bladder has been ruptured by the same local cause as produced a fracture of the pelvis. This result has happened *without* the fragments of the bones inflicting the injury to the viscus. An instance of this injury is related by Mr. Partidge, in the *Pathological Transactions*, vol. v., p. 194. The consequences of these injuries are usually so severe that the prognosis is most unfavorable. The treatment of the case will not differ from that before described.

2. Foreign bodies may inflict injuries on the urinary bladder, after penetration of the abdominal walls; from the neighboring canals; or from the excretory canal, the urethra; and, lastly, fragments of the pelvic bones may lacerate or penetrate its walls.

Penetrating wounds of the abdominal walls produced by projectiles from firearms, bayonet and sword thrusts, nails, spikes, the horns of animals, or surgical instruments, may extend into the urinary bladder. Bullets have lodged in this viscus, and remained in its cavity sufficiently long to become covered with deposits from the urine. Some interesting cases are related by Mr. Guthrie,⁵ to which, and to

¹ Edinburgh Monthly Journal, 1848; the vol. for 1849; and the Glasgow Medical Journal, 1859.

² Edinburgh Monthly Journal, 1859.

³ Dublin Journal of Medical Science, 1836, vol. ix., p. 349.

⁴ Dublin Quarterly Journal, 1868, p. 306.

⁵ Commentaries on the Surgery of War, 5th

results, of a contused wound of the urethra. A man thirty-eight years old fell astride the back of a chair, and very soon afterwards passed blood from the urethra. Five hours after the receipt of the injury he was admitted into Guy's Hospital. The bladder was distended, blood flowed from the urethra, and he was suffering much from local pain. I introduced a large flexible catheter, through which the urine flowed freely without blood. This was secured to the penis, and allowed to remain in the bladder the three succeeding days. The catheter was then withdrawn, as the urine could not pass through it; but I was unable to introduce another. The instruments seemed to run behind the prostate gland. As the man could not void urine, I incised the perineum along the line of the raphé. This region contained much extravasated blood, and the urine flowed freely from the wound. Everything proceeded satisfactorily until the sixth day after the operation, when profuse hemorrhage occurred. It was arrested by applying cold and pressure. At the end of a month after the injury the perineal wound was entirely closed, and all the urine voided by the urethra. When he left the hospital there was no contraction of the urethra, for I could pass a large metallic sound without causing any pain.

The most extensive injury to the urethra and surrounding parts may exist without there being any indications in the perineal region for some time after the accident.

A young man was brought into the hospital who had fallen astride one of the large hooks which connect railway carriages. A few hours after the accident the perineum showed no signs of injury, and a little blood only passed per urethram. He desired to micturate; made an attempt to empty the bladder, but failed to pass a drop of urine. I introduced a flexible catheter without difficulty, and drew off an ordinary amount of urine tinged with blood. I withdrew the catheter, surmising that no impediment would subsequently arise to prevent the introduction of an instrument. However, greatly to my disappointment, the next time micturition was desired, the patient was unable to pass a drop of urine, and a catheter could not be introduced into the bladder. During the interval which had now elapsed since the introduction of the catheter, the integuments of the perineum and scrotum had become ecchymosed, swollen, and painful on pressure. An incision was made through the integuments along the whole extent of the raphé, and the severity of the injury was at once detected by gentle examination with the finger. The tissues, covered by the integuments, were extensively torn, the prostate gland could be felt; but as a very large quantity of extravasated blood filled the perineum, the wound of the urethra was not discoverable. Soon after the perineum had been incised the urine escaped at the wound, suppuration was established, and cicatrization proceeded favorably. The man was able to pass water from the urethra in a very good stream. After a time, however, the cicatrix of the urethra contracted, and a phosphatic calculus formed in the bladder. This was extracted by the lateral operation; the wound healed favorably, and the man passed water in a very

good stream when I last saw him. In this case, it is not probable that the urethra was completely divided transversely.

The following case is one of complete transverse division of the urethra in the perineum. A boy, fourteen years old, was brought into Guy's Hospital in January, 1858. The penis, scrotum, perineum, and hypogastric region were black with effused blood. Retention of urine had existed many hours, and the distended bladder could be felt, as high as the umbilicus. This injury had been produced by a fall astride a rail. There was not even a scratch on the integuments anywhere. Of course, an attempt was made to pass a catheter, but it could not be introduced into the bladder. I therefore made an incision along the line of the raphé, and the urine soon began to trickle away; but I was unable to discover the vesical end of the urethra. All the urine passed through the perineal wound for some weeks, but, by degrees, through the whole length of the urethra. Only a few drops escaped by a fistulous opening in the perineum. After unsuccessful attempts to close this, I divided the perineum and urethra upon a grooved staff, and introduced a flexible catheter, in the hope that the urethra might be established by healing over it. In this I was disappointed; and the boy left the hospital with the urethra contracted, and the urine passing out of the perineal fistula. He next entered another metropolitan hospital, where the surgeon, by the performance of an operation similar to that above described, succeeded in closing the fistula, re-establishing the urethra and keeping it pervious, so long as instruments were daily employed to prevent contraction. The boy left the hospital, neglected to pass the bougie, and the urethra contracted. He then suffered from retention of urine; a No. 1 catheter was passed, and by increasing the size of the instrument the urethra was dilated. Urinary abscesses subsequently formed in the perineum, fistulae were established, and to cure these the perineum was divided as before. This wound never entirely closed; he was again admitted into Guy's Hospital, suffering with stricture and perineal fistula, and left it only slightly relieved. In April, 1869, he again came under my care. The last few months he had passed in great distress. There was a small fistula in the perineum, through which he voided all the urine. I could not pass an instrument along the urethra beyond the perineum. The canal was quite closed. From the perineal fistula a probe readily passed into the bladder. That viscus was inflamed, and his constitutional powers were very low. I divided the perineum, in the middle line, and established a free communication with the anterior division of the urethra. In due time this operation was attended with complete success, and the man, now twenty-seven years old, left the hospital passing urine easily through the whole length of the urethra, but with a perineal fistula.

The danger to life resulting from extravasation of urine into the pelvic connective tissue, as a consequence of rupture of the urethra and laceration of the surrounding textures, is illustrated by the following case. It also demonstrates the ill effects arising from delay in cutting open the perineum, as well as from plugging the part with a sponge to arrest hemorrhage.

of the prostate usually heal very quickly. Such are those made in the operation of lithotomy. The most common injury to which this gland is liable arises from laceration either of one of its lateral lobes, or of its posterior and central part, by the forcible perforation of its tissues with sounds and catheters. This injury can scarcely be regarded as of rare occurrence, judging from the number of specimens accumulated in the museums of London. The growth connected with this gland, and denominated the "middle lobe," is frequently so situated at the orifice of the urethra as to offer an impediment, not only to the flow of the urine, but to the introduction of an instrument from the urethra. This contingency should be always remembered when any obstruction is met with at the moment the catheter reaches the orifice of the bladder. The perforation of this lobe is readily effected with a metallic instrument; it may, with care, be avoided, by the employment of a flexible catheter and stilette in most cases. When the end of the instrument impinges on the obstruction, it should be drawn from the urethra about half an inch; then, by fixing the catheter with one hand, drawing the stilette out of it for about an inch with the other, and depressing both hands, or gently pressing the catheter onwards by itself, it glides over the third lobe and enters the bladder.

The indications of perforated prostate may not be immediate. But, after the lapse of an hour or two, the patient experiences an urgent desire to empty the bladder. He repeatedly attempts to do so, but in vain. Perhaps a few drops of blood escape from the urethra. Becoming alarmed, he sends for a surgeon, who finds the pubic region occupied by a hard mass, which is very painful when pressed. The surgeon again introduces a catheter, but no urine escapes. By dint of pressure above the pubes a few drops of urine mixed with blood are expressed, then a long coagulum, again a little more blood and urine, and next a coagulum, and so on until the mass in the pelvis is somewhat reduced in size. But still there it remains, and, as an accompaniment, the urgent desire of the patient to empty his bladder. Together with these local circumstances, the constitutional disturbance hourly increases; mental excitability for a few hours is associated, at a later period, with great restlessness. Nausea, and intolerance of solid food, with a clammy white tongue, changes after a time to vomiting, continued retching, and the attendant distress. The clamminess of the mouth passes into a state of parched dryness, and the thirst is most distressing. The tongue becomes dry, brown, crisp, and rough on its surface. The pulse, at first full, rapid, and incompressible, by

degrees becomes small and wiry, maintaining its rapidity, although, perhaps not regularly. Respiration is at first accelerated, and lastly hurried. The skin is covered with perspiration, which in the later stages becomes cold, and the face assumes a congested, livid aspect, not unlike that seen in cases of peritonitis.

The first thought which suggests itself to the patient as well as the surgeon, will be to relieve the distended bladder. How is this to be effected? The introduction of the catheter gives no relief, and even the passage of the instrument through the injured prostate might tend to reopen the wound. However this may be, I consider the best plan is to introduce a large metallic or flexible catheter; and then, by applying at its end a syringe, as before described, the blood may be abstracted. The bladder may be irrigated with tepid water, and the operation repeated if necessary. Cold water injected into the rectum may arrest any further bleeding.

The powers of the patient must be well supported, and sedatives or opiates administered to obtain repose.

I have never met with any injury of the vesiculae seminales.

Injuries of the scrotum and testicles.—The scrotum is often contused, and the effect of the laceration of small vessels ramifying in its textures is shown by effusion of blood taking place in the loose connective tissue of the organ. This causes it to swell and become of a black hue. The treatment of a case of this nature demands perfect rest, with care and arrangement to prevent the part remaining pendent whilst the patient is in bed. A small pillow or sand-bag should be placed between the thighs. The most suitable application is a slightly stimulating and evaporating lotion, which may be composed of liq. ammon. acetatis, spirit. tenuior, and distilled water, in suitable proportions. [Cold water does very well.] Lint wetted with this fluid should be placed over the injured part.

Incised and lacerated wounds of the scrotum are produced by falling upon sharp substances, or astride of rails, hooks, etc. The wound is sometimes sufficiently large to permit the escape of one or even both testicles without their undergoing any injury. This extrusion of the testes partly depends upon the contraction of the fibres of the dartos, which corrugates the scrotum, and causes it to shrink to such a degree, that it might appear as if a considerable portion of the structure had been carried away as the result of the injury. Such not being the case, means must be employed to relax the contractile fibres of the dartos. Warmth and moisture will accomplish this. The region should be en-

Fractures and Dislocations of the Bones of the Upper Extremity, treated at the Middlesex Hospital, during sixteen years, ending June 30, 1867.

A. FRACTURES.

B. DISLOCATIONS.

FRACTURES OF THE BONES OF THE UPPER EXTREMITY.

Fractures of the Clavicle.

The clavicle is more frequently broken than any other bone in the body, the radius excepted. Although met with at all ages, this accident is most common in infancy and early childhood: nearly one-half of the entire number of cases recorded in the

above table occurred before the completion of the fifth year.

Up to this period its relative frequency in the different sexes is nearly equal; at all subsequent ages men are much more liable to it than women.

Sometimes the fracture is caused by direct application of force to the bone, as by a heavy blow, or a wheel passing over it, or a fall in which the body of the bone comes into contact with some hard sub-

Hartshorne, of Philadelphia), the correction of this scapular displacement relieves the deformity at the seat of fracture. Dr. Edward Hartshorne (Penn. Hosp. Reports, vol. ii., 1869) urges the use of a back-splint, making pressure "directly upon the lower blade of the scapula about and just above its angle, behind the chest." To the pressure made upon the scapula the same writer attributes the favorable results of the "posture method," *i. e.*, the keeping the patient upon the back in bed.]

Fracture of the sternal extremity of the clavicle is a very rare accident. Lonsdale,¹ relating the case of a child three years old, in which the clavicle was fractured about half an inch from the sternum, conjectures that such cases arise from separation of the epiphysis. This, however, clearly cannot be, as the epiphysis at the sternal end of the clavicle is an extremely thin plate of bone, and commencing to ossify at about the age of eighteen, is joined to the bone a few years later; if, then, such an injury could happen, it would be only at this particular period of life. Blandin² describes a case in which the clavicle was fractured between the costo-clavicular and sterno-clavicular ligaments, without displacement; but in the only two specimens of similar fracture that Malgaigne³ could find in the Musée Dupuytren, the external fragment was displaced considerably downwards and forwards.

Two examples of this accident recently occurred at the Middlesex Hospital. Both patients were girls under ten. In one the fracture, produced by indirect violence, was about half an inch from the sternal

Fractures of the acromial extremity of the clavicle are much more frequent than the last. R. W. Smith¹ has shown, from examination of specimens of bones after death, that the outer end of the clavicle may be broken, either between the conoid and trapezoid portions of the coraco-clavicular ligament, or between this ligament and the acromio-clavicular articulation. In the former situation the fracture is of comparatively rare occurrence, and attended with scarcely any displacement of either fragment of the bone; in the latter, on the contrary, there is generally a considerable amount of displacement of the outer fragment; its inner end being drawn upwards and outwards by the action of the clavicular portion of the trapezius muscle, while the outer or articulating surface is directed downwards and inwards by the weight of the arm and the action of the muscles passing from the chest to the shoulder. This displacement is sometimes carried so far that in some of the cases examined, the outer fragment had united to the other at a right angle.² The inner fragment is not materially altered in position, unless the coraco-clavicular ligament be ruptured.

An *incomplete fracture* of the body of the clavicle, sometimes attended with *bending* of the bone, is occasionally met with in children. Vide FRACTURES, p. 484.

Comminuted fractures of the clavicle are not unfrequently the result of violence, and are easily recognized by the great mobility of the fragments.

Compound fractures of the clavicle are extremely rare [it might almost be said that they never occur except as the result of gunshot wounds, so rarely are they consequent upon injuries of other kinds]; and notwithstanding its vicinity to the large vessels and nerves of the neck, serious complications from implication of the soft parts do not often follow fractures of this bone.

Among the severe injuries which occasioned the death of the late Sir Robert Peel, was "a comminuted fracture of the left clavicle, below which a swelling as large as the hand could cover, and which pulsated synchronously with the contractions of the auricles of the heart, formed." This was evidently the result of a wound of some large vein, probably the subclavian, by the broken ends of the bone. From the intense pain suffered, it was also

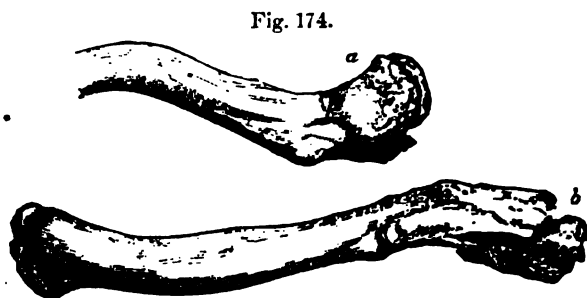


FIG. 174. Extremely oblique fracture of the acromial end of the clavicle. a, under surface; b, anterior view. From a preparation in the Middlesex Hospital Museum; Cat. No. 1, 15, d.

joint, and the displacement was very slight: in the other the fracture, caused by direct violence, was a little further from the sternal joint and there was more displacement.

¹ Op. cit., p. 206.

² Gazette des Hôpitaux, 22 avril, 1845.

³ Op. cit., tom. i., p. 491.

¹ Op. cit., p. 200.

² This observation is corroborated by a recent specimen exhibited by Mr. Canton to the Pathological Society, Nov. 6th, 1860.

too active movements on the part of the patient these adhesions become disturbed or destroyed, all previous benefit may be entirely lost, and a fatal termination be the result.

The following case indicates the extreme importance of strictly maintaining the recumbent posture after severe collapse.

A man, aged forty, was admitted into St. George's Hospital in May, 1845, under the care of Mr. Catler. The patient was in a state of collapse, and complained of intense pain over the abdomen, which was considerably distended; some of the ribs on the right side were fractured. The pain gradually subsided, though the patient remained very anæmic. He appeared to be gaining some strength, when he died suddenly, three days after the accident, on attempting to raise himself up to get upon the bed-pan. The cavity of the peritoneum contained a large quantity of blood. The convolutions of intestines were glued together by the fibrin of the extravasated blood, which had partially lost its color, and formed slender adhesions. There was an extensive rupture of the liver. The ruptured parts were well adapted to each other, and pretty firmly united by the fibrin of the extravasated blood.

That a rupture of the liver may unite, and that a patient need not die from the effects of such an injury, there can be no doubt: the following case is an illustration.

A man, aged thirty-eight, was admitted into St. George's Hospital, under the care of Mr. Omar Hawkins. The patient had fallen from a hay-rick, and struck his back against a log of wood. There was complete loss of voluntary motion and sensation in the parts below the nipples. There was considerable collapse, which continued for several hours. The urine drawn off contained a large proportion of blood. Clots formed upon the back, etc., and death occurred exactly three weeks after the accident. The body of the seventh cervical vertebra was broken into fragments, and the spinal cord corresponding to this vertebra was softened and diffused. The cavity of the peritoneum contained a little bloody serum. An extensive rupture was found on the upper surface of the right lobe of the liver; this rupture, which measured five inches in length, was perfectly united, with the exception of some few points, where the peritoneal coat still remained broken; but no lymph was found on the serous membrane, which retained its polished surface. The rupture did not extend very deeply into the organ.¹

Such a rupture as the above, occurring without other mischief to the body, may reasonably be considered as by no means fatal in its character, nor in this instance can the injury to the liver be looked upon as at all implicated in the cause of death.

In conclusion, from the results of the cases quoted, and for the reasons adduced, we may fairly state that the treatment of

the convalescent is a matter of as great importance as that of the patient in the early days of an injury suspected to be laceration of the liver.

Rupture of the *gall-bladder*, or of the common duct, may occur without rupture of the liver. The symptoms are generally marked,—considerable pain in the region of the injury, excessive collapse, and great anxiety. Death is generally rapid; and post-mortem examinations have detected the escape of the bile into the cavity of the peritoneum.

Mr. Poland relates the following case. "A boy received a blow on the abdomen, followed by great pain and speedy death. There was found extravasation of bile, and rupture of the ductus communis chole-dochus, with lymph thrown out in the neighborhood."²

Dr. Fergus has recorded an interesting case of rupture of the gall-bladder, in the 31st volume of the *Medico-Chirurgical Transactions*. A boy, aged seventeen, fell off the shaft of a cart, the wheel of which passed over the abdomen, just below the false ribs. The boy complained of pain in the abdomen, but not of a severe character; the amount of shock was trifling. In the night following the accident, severe pain commenced in the abdomen—the countenance became anxious and the pulse small and rapid. These symptoms were actively treated, and he improved so much that on the fifth day after the receipt of the injury he was considered convalescent, and was allowed to get up. Two days subsequently, he was so far recovered, that the question of his quitting the hospital was entertained, when about noon he was suddenly seized with extreme pain and a sense of tightness in the abdomen: in an hour the pain had extended all over the abdomen, and was increased by pressure; the countenance was full of anxiety, and the pulse small and rapid, the symptoms present were those of acute peritonitis, from effusion of foreign matter in the cavity of the abdomen. Notwithstanding the most judicious treatment, the symptoms increased in severity, and the patient died on the ninth day after the first receipt of injury.

On opening the cavity of the peritoneum, an immense gush took place of a dark liquor, having precisely the color and odor of bile. The intestines were roughened from the effects of peritonitis, and shreds of lymph were floating in the dark fluid. "The liver was lacerated in the direction taken by the broad ligament, quite through its substance, and to a depth from the thin edge of two inches and a half; another laceration extended about two-thirds of the length of the convex surface in a transverse direction. The omentum was found rolled up in a mass underneath the liver, and slightly adherent to it, of a dusky dark color, and gave way under the least pressure. The neighboring portion of the transverse colon was of the same color, and nearly as fragile. The gall-bladder was ruptured above, near the junction of the hepatic with the cystic duct, at a spot in immediate relation and in contact with the mass of omentum above described;

¹ Cases of Ruptured Liver, by Mr. Johnson, *Med.-Chir. Trans.*, vol. xxxiv.

² Prize Essay, by Alfred Poland.

live urine, mixed with pus, was constantly passed. There was every evidence of abscess of the kidney: the quantity of pus was sometimes very considerable. The health became gradually deteriorated, and death occurred about two years subsequent to the accident.

The left kidney was entirely destroyed; and in its situation was found a large irregular abscess, with its walls adherent to the surrounding soft tissues, and its cavity continuous with the ureter.

Without much more external evidence of bruise than in the previous case, very extensive laceration of the kidney may result from a blow over the lumbar region.

A boy was struck, over and rather in front of the right lumbar region, by the handle of a truck, in consequence of the truck coming in collision with a wagon. From the violence of the blow, the boy was forced against a post of a gateway. He immediately fell, and though able to rise and walk a few steps, he again fell, and was then carried to Guy's Hospital. He was in a state of extreme collapse, with some pain in the abdomen. He died within an hour and a half of the accident.

Externally there was slight ecchymosis over the extremities of the seventh and eighth ribs on the right, and the last two ribs on the left side. The cavity of the peritoneum contained a large quantity of coagulated and fluid blood. All that portion of the left kidney above the entrance of its vessels was torn from the lower portion, and was separated from the natural surrounding attachments. The lower portion was not disturbed in its position. There was some ecchymosis on the surface of the liver, opposite to that on the chest.¹

In proportion to the severity of the injury must we anticipate different features in the symptoms which accompany laceration of the kidney. Generally there will be excessive collapse, attended by early vomiting; pain referred to the course of the ureter, as well as to the lumbar region; retraction of the testicle and frequently great pain referred to the testicle itself and to the lower part of the abdomen; and numbness of the upper part of the thigh. All these symptoms will probably increase in severity, should the patient survive, and infiltration of urine occur. The urine drawn off will be high-colored and scanty, and will generally be much tinged with blood, often containing a very large proportion of blood. There will frequently be observed, passed through the catheter, long, thin coagula, casts of the ureter, taken by the blood, as it coagulates in its passage to the bladder.

Should the rupture of the kidney be confined to the anterior surface, and any escape of urine occur through the lacerated part, acute peritonitis will rapidly follow. If the rupture be confined to the posterior surface, and urine be extravasated into the subserous cellular tissue, though the symp-

toms may, in the first instance, be less indicative of peritonitis than in the former condition, suppurative inflammation will soon be marked by its characteristic symptoms; and rigors, high fever, typhoid tongue, and oedema of the parts in the neighborhood of the injured organ will telegraph the mischief immediately threatening life.

There is no question, however, that a rupture of the kidney need not be necessarily fatal. The following case is a fair illustration of recovery from such an accident.

A man, aged thirty-seven, in June, 1858, was taken to St. George's Hospital, having been kicked by a horse. The patient was very faint on admission, and became so much worse after a very short time, that it was supposed he was dying. However, he rallied by degrees. After a short period, a swelling was observed in the region of the liver. The belly commenced to swell, and continued to do so for some time. The urine at first passed was mixed with blood; on the day following the injury, there was less appearance of blood; and, subsequently, the urine was free from blood. He gradually recovered under careful treatment, so as to leave the hospital July 20, about six weeks after the accident, in a pretty good state of health and comfort. On Dec. 14, 1859, he was readmitted, suffering severely from anasarca, oppressed breathing, and urine loaded with albumen. He died Dec. 22.

There were numerous adhesions uniting the right lobe of the liver to the diaphragm, but there were no absolute marks of recent rupture. Both kidneys were small, granular, and full of cysts. The cellular tissue around the right kidney was much consolidated. A large clot of blood occupied the pelvis and the interior of this kidney, and communicated also with the exterior of the organ, where a considerable quantity of coagulum lay in the subperitoneal substance around the gland. The line of rupture of the kidney could be faintly traced through the substance of the gland. The blood was solid, and only partly decolorized. The ureter was completely impervious with coagula.¹

We may conclude that recovery is a result almost entirely dependent on the extent of rupture; if the latter be slight, recovery may readily occur—if extensive, treatment is hopeless and death certain.

A man was admitted into St. George's Hospital, under the care of the author, with severe pain in the right side of the abdomen and loins; the result of a fall. The urine drawn off was loaded with blood. There was much tenderness on pressure, and some tumefaction with resistance of the abdominal muscles on the side affected. Symptoms of acute peritonitis supervened, and the patient died in a few days.

A post-mortem examination disclosed a kidney nearly divided in two, on the right side, with extensive extravasation of blood around

¹ Prize Essay, by Mr. Poland.

¹ Path. Soc. Trans., vol. xi., p. 140.

leading to a suspicion of injury to any part of the urinary apparatus."

We have already alluded to the possibility of recovery after laceration of a kidney on its posterior surface. The cases recorded by Mr. Stanley tend to confirm this view; and they also indicate the advantages of an early exit being given to the contents of any abscess, or cyst, the result of extravasation of urine. Regarding this point of treatment, Mr. Stanley observes: "It may, however, be a question whether the best proceeding would be gradually to withdraw the fluid by repeated punctures of the cyst, and thus to favor the collapse and adhesion of its sides, or whether the urinary cyst should be punctured at its lowest part, in the view of maintaining the aperture free for some time, that the fluid may drain from it." Provided the fluid be at all purulent, the latter method of treatment would no doubt be most judicious.

WOUNDS.

1. *Wounds of the parietes without protrusion of viscera.*—We now enter upon that division of our subject which treats of wounds of the abdominal wall, occasioned by a variety of weapons or instruments, without injury to, or protrusion of the viscera. Wounds of the walls of the abdomen are very common, and occur from a great variety of sharp or pointed substances, intentionally or accidentally thrust against, or that suddenly come in contact with the surface of the belly.

Sharp or pointed instruments usually produce clean incised or small penetrating wounds. The larger wounds of the abdomen are the results of persons being caught on hooks, or impaled on iron spikes; falling on china, or through glass; being tossed by horned cattle, or lacerated by the teeth of carnivorous quadrupeds. The extent and character of such wounds will therefore vary in every possible degree, and will depend in as great a measure upon the amount of force by which the instrument of injury is propelled, at the time of the accident, as upon the shape of the instrument and the direction in which it enters the body.

Superficial incised wounds of the abdominal wall are not generally dangerous in their character, nor troublesome to manage, provided the viscera escape bruise or other injury at the time of the accident. Lacerated wounds, when superficial, may also be considered free from much danger. But deeper wounds, whether incised or lacerated, without injuring the peritoneum, are more serious; from the fact, that there is always a liability to suppuration, burrowing deep, and extending in various directions under the muscles and fasciæ. The

principles laid down for the treatment of wounds in general must be applied to those of the abdominal wall. Hemorrhage, if it exist, must be arrested. Care must be taken to clear the wound of any foreign substance accidentally lodged in it; such as glass, china, or portions of instruments broken off by the force of the blow which inflicted the injury. It has frequently occurred that large foreign masses have been overlooked, and allowed to remain buried, for many months, in the muscular wall of the abdomen after an accidental gap made by some sharp cutting material.

A sailor was admitted into St. George's Hospital, complaining of pain over the right lumbar region, produced apparently by some solid substance lodged underneath the integuments. Mr. Babington cut down upon the mass, and extracted the shaft of an originally three-pronged steel fork, now minus a handle, and with only two prongs attached, one prong having been broken off some time previously.

Scrupulous attention having been paid to the condition of the wound, and it having been ascertained to be free of any foreign substance, the treatment should be very simple. The abdominal muscles are to be relaxed by position, especially if the edges of the wound have the least inclination to retract. As a rule, sutures will be found most advantageous and effective in approximating and retaining the edges in apposition. Metallic wire sutures appear to offer many advantages over silk, in such cases.

It must, however, be borne in mind that in wounds of any depth about the abdominal walls, especially in the thicker parts, or wherever the muscles overlap each other, it will be found difficult, if not impossible, to maintain perfect apposition of the whole surface of the cut. There is always in such wounds a tendency for fluid, serous or sanguineous, to accumulate between the surfaces at the deepest parts. The existence of such fluid may be followed, in a comparatively short time, by foul suppuration; which, if allowed to remain confined, would produce alarming constitutional disturbance.

A man, æt. 31, was admitted into St. George's Hospital, on May 22, 1839, with femoral aneurism on the left side. The external iliac artery was tied by Sir B. Brodie on May 30. On the evening of the day of the operation, there was much pain about the wound, and the parts were very sensitive to pressure. The tongue was already brown and dry. On the following morning, the pain was more diffuse, but less intense; the tongue still brown and dry. The left side of the abdomen was hard and tender to the touch. The next morning, June 1, the pulse was 136, and small; the tongue brown and dry; countenance anxious; pain only referred to the neighborhood of the wound. The

through the muscles, but not the peritoneum, the wound may prove fatal from peritonitis secondary to the suppurative stage, if not fatal from peritonitis the immediate result of the accident.

Under all circumstances, therefore, the utmost precaution in treatment is necessary. Perfect rest; relaxation of the abdominal muscles, by a posture somewhat bent forward; the stomach and bowels to be kept moderately empty by the administration of fluid food only; and the administration of opium as indicated by symptoms, will constitute the chief points of medical management. The local treatment of the wound is not a consideration of importance here; if there be suppuration, the point beyond all doubt is, that it have free vent; irrespective of that, the treatment is of the simplest kind. Peritonitis supervening on these accidents cannot often be met by active or heroic treatment; leeches should not be spared if necessary and if the patient can bear the loss of blood. The practitioner will find in most cases an invaluable auxiliary in opium; but science, judgment, and experience must regulate the treatment in each individual case, according to symptoms. No definite law can be applied to the complications which so often arise in the progress of these cases.

Suppuration will be indicated by increase of heat about the wound, redness, tumefaction, and tenderness. These symptoms will soon be followed by heat of body, increase of pulse, thirst, a brownish dry tongue, rigors, and perhaps wandering sleep or delirium. It may even happen, if the wound be deep, and the symptoms severe, that the constitutional disturbance is so rapidly increased in amount that death takes place in an unexpectedly short period. It is well, at all times, to be very guarded in any opinion offered to the anxious relatives of a patient, the subject of such an accident. In rapidly fatal cases the cellular tissue and the fascial interspaces will usually be found infiltrated with pus and lymph to a surprising extent; and not unfrequently purulent effusion will be observed on the surface of the intestines.

Should the patient survive the early inflammatory and suppurative stages following a punctured wound of the abdominal wall, the suppurative action may spread at intervals in various directions, and abscess after abscess present in different positions until he becomes worn out and dies; or sometimes when the patient may be said to have placed his hand on the door leading to death's chamber, the symptoms commence to show a favorable turn. Suppuration becomes healthy in character and diminished in quantity. Sinuses gradually close, and time slowly replaces the sufferer in a position of safety; he rises from his

couch convalescent, but most probably somewhat crippled, either from suppuration having extended below Poupart's ligament and having implicated the muscles of the thigh or neighboring articulations, or from the contracted position in which, for many weary days, he has been confined to bed.

In the abdominal wall a condition sometimes remains, after a wound of the parietes has healed, to which the attention of the surgeon must be directed—we allude to the protrusion of the parietes at this part. This protrusion is the result of the action of the abdominal contents against the cicatrix, which thins out and yields more readily than the natural healthy abdominal wall. Such a protrusion constitutes one of the forms of ventral hernia. Usually the protruding viscera push before them evenly the now stretched cicatrix and surrounding tissues, so that the base of the prominence is larger in circumference than any other portion. There is no so-called neck to the cavity which contains the viscera, so that the latter run little risk of strangulation. No difficulty is encountered in an attempt to push back the contents of the prominent mass; the difficulty is to restrain the viscera from again bulging forward. As there is no danger of strangulation, it is only necessary to support the parts by means of a large pad and a well-adjusted bandage.

2. *Wounds of the abdomen, with protrusion of the bowels or portions of the viscera through the aperture*, are by no means rare accidents; such a protrusion constitutes a hernia without a sac.

The character of the wound will in a great measure regulate the amount of the protrusion, just as the situation of the wound will to some extent permit only certain viscera or portions of them to be protruded. In punctured and small wounds a part of the intestine, omentum, or both, may escape through the aperture. In incised or lacerated wounds larger portions of either, or both, and even portions of the stomach, liver, etc., may protrude externally. In the former kinds of wounds the protruding viscera are very apt to be constricted at their point of exit from the cavity of the abdomen; a condition little liable to happen in the lacerated or large incised wounds. The viscera most frequently met with protruding through the wounds of the parietes of the abdomen are the small intestine and omentum; for as the mobility of the part, so is the greater facility of its displacement. But stomach, large intestine, and even liver and spleen, have been found lying outside the abdomen in wounds, the result of accidents such as we are about to consider.

We presume, as the first consideration

that there are some differences of opinion on this point. The opinion now arrived at is the result of a careful consideration of the practice observed at St. George's Hospital for many years past. Be it remembered, however, that whether the omentum be returned, or whether removed, the external wound should be brought together at once, and should have nothing protruding between its lips, except the ends of the ligature passed round the omentum. [In the light of present experience, in the use of ligatures in ovariectomy when adhesions must be torn and vessels ligated, it is safe to predict, that the practice of leaving the ends of ligatures hanging out of abdominal wounds, in cases in which the omentum has been tied and cut, will not long be continued; but, that the ligatures will be cut short and returned with the omentum into the abdominal cavity]. The removal of omentum *must never be attempted under any circumstances*, without the base of the portion to be removed being safely secured by ligature. If this precaution be not heeded, very formidable, if not fatal, hemorrhage may result from the vessels divided. And again, it is safer to pass the double ligature through the base of the omentum rather than trust to a single ligature tied round it; we thus avoid the possibility of the ligature escaping from off the stump of omentum, which is left in the wound after the greater portion of the protruded mass has been cut away.

With the exception of omentum, all other protrusions of viscera must be invariably reduced, and as early as possible.

It has been already stated that the small intestine is more frequently protruded than portions of other viscera, after wounds of the abdomen; the transverse colon and the stomach come next, each in its order. The wound of the parietes must be extensive to allow of the protrusion of liver or spleen. But yet there are cases on record, and those not few, which bear witness that portions of most of the viscera may escape through an opening in the abdominal wall. In a practical point of view it does not matter what the protrusion may consist of, irrespective of omentum; for, provided the mass be healthy, *it must be returned*. It is only the amount of the protrusion which will to some extent affect the steps of the treatment: for if the wound be small, and the mass protruded large, in all probability the former must be enlarged before the latter can be returned. In lacerated or incised wounds the probability is that reduction is readily effected.

The rules propounded respecting the propriety of reducing the omentum when protruded, will apply to some extent to the treatment of protruded intestine. The latter, when examined soon after an acci-

dent, may be found reducible readily through the wound. In such case the precautions necessary are, to see that the intestine is clean—its surface free from dirt, hairs, straw, or other matters which the contact of clothes, etc., may occasion to adhere to the moist peritoneal covering; that the bowel is not bruised or ruptured; that no portion of the instrument which occasioned the wound is lodged among the folds of the intestine. The surface of the bowel must be well cleared of all adherent materials, by being bathed gently with tepid water, and, if otherwise sound, be at once returned into the abdomen.

If the bowel, as regards its integrity, etc., be in a condition favorable for reduction, we may nevertheless find that it is irreducible. This circumstance may be the result of a great amount of viscera protruded, or of the protruded portion having become much distended by flatus, or thickened by congestion—or of a wound, contracted when compared with the size of the mass external to it. If the difficulty in reduction arises from the smallness of the wound, the means to be adopted have already been mentioned. If such difficulty depends on the distension of the bowel by flatus, that condition may often be overcome by very gently and carefully pressing the air back into the portion of intestine within the abdomen. This attempt, however, may entirely fail, and only by an extension of the wound can a very large mass of greatly-distended intestine be returned into the abdomen. In instances of very large protrusion, with *excessive distension*, to puncture the bowel with an exploring needle is a practice which has been adopted successfully; but, on the other hand, such practice has been strongly condemned by several writers. It has been urged that the small punctures cannot be of service, as they will soon be filled up by the mucous coat. However, as they are only wanted for immediate relief, this objection is not of much value. Such treatment can only be requisite in extensive protrusion of bowel largely distended, and where there is much difficulty of reduction.

Mr. Tatum reports a case in which he adopted this treatment with success. A patient was operated on for inguinal hernia, and the medical man found after dividing the stricture, that so large a mass of bowel protruded that no effort on his part would succeed in reducing it. Mr. Tatum was called in, and examining the condition of the parts, found the space between the thighs occupied by a large volume of intestine, extending nearly down to the knees. "It was found to be composed of the whole, with a slight exception, of the jejunum and ileum, enormously distended with flatus, and of a bright-red color." With a grooved needle, Mr. Tatum made three or four punctures, allowing the flatus to escape by the

openings of the upper and lower portions of the gut. In proportion to the projection of this fold into the wound, so is the obstruction to the passage of the contents from one opening to the other. The fold may even, and often does, project sufficiently to lap over the lower opening, and then will conduct the whole of the contents of the upper division of the bowel directly outwards through the artificial anus. The fold, to which we have now drawn attention, constitutes an important feature in the ultimate condition and in the treatment of artificial anus, to this fact we shall refer presently.

Such, then, are the general external characteristics of artificial anus. We have now to examine the conditions, within the abdomen, of the portion of bowel implicated in the opening. If we trace a convolution of the upper portion of the intestine towards such an aperture, on approaching the latter, the bowel will be observed, within the last few inches, to form an angle more or less acute with the portion of intestine which forms the commencement of the lower division. According to the amount of destruction of the bowel, and the prominence of the fold of mucous membrane within the wound, will be the acuteness of the internal angle; and if the angle be very acute, in consequence of extensive destruction, the portions of bowel forming the angle will lie more or less side by side, or sometimes across each other, as they approach the fistula. The serous surfaces of these opposed portions are not generally adherent to each other. Intestinal convolutions may dip down between them, and even push forwards a serous sac into the artificial opening. This is an important fact, viz., that the mass of intestine within the abdomen is only protected externally, at the artificial opening, by the thickness of the wall of the adherent bowel. The serous surface of the intestine, where the latter is adherent to the abdominal wall, is continuous with the parietal peritoneum all round the false opening; for the two serous surfaces, parietal and visceral, have become adherent to each other, either previous to the sloughing of the bowel in a hernia, or subsequent to the wound of the intestine in an injury. The adhesions, which unite the intestinal to the external orifice, occur first on the peritoneal face of each opening, and are at first slight, but subsequently become more firm as they become vitalized. But the extent of such adhesions is never broad, nor capable of offering much resistance to the pressure of the viscera within. Sir W. Lawrence justly observes, "The abdominal cavity is protected at the margin of the opening by a feeble barrier: the extent of the adhesions being only from half a line to a line, some-

times, but rarely, reaching an inch."¹ As the membrane of the bowel attached to the orifice is continuous with the parietal, so the membrane lining the intestine is continuous with the cuticle of the artificial anus with the

Such, then, are the conditions usually found in artificial anus; certain variations, dependent on local conditions, the result of a wound of the large intestine, or of an opening made in the lumbar region for the removal of the bowel, the probability of a mucous membrane will be observed when any considerable portion of the small intestine has been removed. When the opening is high, as in the jejunum, the contents are less offensive than when it exists in the lower part. When the opening is in the lower part, the discharge often contains feculent masses, and is always of that passed naturally. Within also, when the opening is complicated, there need be no artificiality in the natural position of the bowels; need be no angle formed by the lower portions of the intestine; and there need be no adhesion of the serous surfaces to the abdominal wall. The bowels may have been removed, and the serous sac.

Certain changes will occur, as time passes. An opening, originally small in the intestinal orifice will gradually enlarge, and the escape of the contents will be in proportion to the contraction of the opening. After a few weeks or months, the edges of the aperture will close. If the aperture is originally large, the edges will gradually become less, and then remain static. The edges will often become inflamed, and will also occasionally become adherent inwards; at the same time the membrane which projects from the orifice will gradually direct the passage of the matter which leads into the bowels; for the matter acts constantly on the surrounding surface of this fold, and thus effect the passage of feces from the lower portion of the bowels to the extent and projection of this fold, will the passage

¹ Lawrence, On E

consequent acuteness of the angle at which the portions of the intestine meet at the aperture, and the unavoidable prominence of the *éperon* or fold—conditions which most effectually interfere with the passage of feces into the lower division of the bowel. If the serous surfaces of the two portions of the intestine, within a few inches of the opening, were adherent to each other, nothing would appear more justifiable or easier than to divide the *éperon* some distance inwards, commencing at its free margin; and then this process of treatment would probably be as safe as it would be easy. A direct and free communication between the upper and lower portions of the bowel would be thus immediately established, the *éperon* would be destroyed; the feces would flow along the natural channel more readily than escape externally, especially if pressure was applied over the opening. But it has been explained that the *éperon* is formed merely of a duplication of the mesenteric or attached border of the wounded bowel: the artificial aperture would, in most cases, be situated in some portion of the former free surface. The duplication would therefore consist, within the intestine, of two layers of mucous membrane; within the abdomen, of two layers of serous membrane, and intermediately of the muscular and cellular coats of the bowel. To divide this *éperon* to a sufficient extent to relieve the obstruction it produces, would necessitate cutting into the cavity of the peritoneum; for we should have to cut through the opposed portions of bowel. Even a further risk would have to be encountered. There might be intestinal convolutions lying between those two surfaces of bowel, which must necessarily be divided in order to secure sufficient increase of space in the canal; therefore an instrument carried across the space occupied by such convolutions might seriously injure any portion of viscera there interposed.

To Dupuytren we are indebted for originating a method of treatment which, perhaps of all others, holds out the prospect of dividing the *éperon*, with as little amount of risk to life as can possibly be obtained in so formidable an undertaking. But the fact must be fully appreciated, that any interference with this *éperon*, or projecting fold, must always necessarily be attended by considerable risk of peritonitis, and danger to life.

"Restoration is seldom accomplished by the united efforts of nature and art," writes Dupuytren, "when the loss extends to four-fifths, or to the entire circumference of the intestine, with or without the

mesentery, whatever the mischief in length of the bowel, the con of direction in the gut the ridge and septum, the greatest extent, a superable obstacle to the intestinal course. If compresses sufficient exactness to feces, symptoms of a duce, such as colic hiccough."

Dupuytren saw this into the cavity of could in extreme cases by any means which passage of feces in the probable result of the artificial anus; removal of the *éperon* spect of relief. He attempted to establish tion between the upper of the gut by destroying one or two attempts to sure and ligature, he used an instrument, which *force*. By the application, he considered ridge and septum in a short period. It is state, that this is such that it somewhat resists, the blades of which from each other, or, a septum, can be approached a few, so closely on the part embraced blade, being grooved, the other, when the instrument so that any intervening grasped, is so effectually destroyed in a very it has been decided to "the first step is to find of the intestine, and to the direction taken by portions of the canal, longest and most difficult. The dissection generally points out trouble, the orifice an end. But greater difficulty in discovering the location of the openings of two portions of bowel retained, one branch of introduced into one end according to circumstances depth of one or more branch is placed to a in the other end,"¹ adjusted and firmly fixed

¹ Mémoires de l'Académie de Médecine, tome 1, 1828.

¹ Dupuytren

ion, apparently in the stomach, there a body of the size of a small egg, and per pressure the sensation of friction foreign bodies was elicited. The man ntly appears to have made some vague ts of having repeatedly swallowed idles, sand, and pebbles. He made nplaint, but stated that he often rom severe pain. He vomited occa-

One day, about three months after confession to the attendant, the pa- seized with sudden severe pain in men, which continued to increase the night; and from the effects of k he died the following morning.

vity of the abdomen was filled with enish fluid and much recent lymph. ach was lying in the left hypochon- ion, in rather a vertical position, and a contracted. About an inch and a the pylorus there was a perforation nterior surface of the duodenum of f a swan-quill. On laying open the and duodenum, "a mass of iron idles and nails and other articles n closely packed together." There rty-one entire spoon-handles about s long, four half handles, nine nails, iron heel of a shoe, one screw, four and one button; the weight of the ss was 2 lbs. 8 ozs. An entire spoon- as found in the duodenum, with the extremity towards the pylorus, op- e perforation.

he remarkable instances on record of umber of foreign bodies being swal- tionally, there is none to equal in ne recorded by Dr. Marcet. In this ilor swallowed at different times a f clasp-knives, some thirty-seven in e of these he passed whole, per anum, ds; subsequently he passed some frag- id once he vomited a knife-handle. ime before his death a portion of one ixed across the rectum, but gave so n on examination that it could not ed. He lived ten years after having l the first knife. On examination th, one blade was found fixed across n with one extremity projecting into ilar parietes of the pelvis. A back a knife had transfixed the descend- opposite the left kidney, and pro- to the peritoneal cavity; the spring inches and a half long. In the there were between thirty and forty f knives. For the further particu- is case we must refer the reader to it's interesting report.¹

n bodies which pass into the intes- up to be obstructed in their prog- the ileo-caecal valve. Such is y the case with small bones, fruit- c., and occasionally the mass will ap ulceration, and be followed by i the right iliac region. The cum- lt of such an abscess is general s, and the patient often soon sinks e attack; but less frequently the pens externally, the foreign body or is removed, and the patient

recovers after a severe and prolonged illness. Fruit-stones are apt to become lodged in the appendix, and are a frequent source of mischief. Such stones are sometimes care- lessly swallowed with fruit in large num- bers, and are occasionally retained in the intestines for many months without incon- venience; but are as often the cause of much irritation, and even of troublesome obstruction.

Mr. Clement, of Shrewsbury, operated on a patient suffering from obstruction of the bowels, for the relief of which the ascending colon was opened. The patient was so much relieved by the operation, that at the end of six weeks she was able to walk about. About a week subsequent to this period she was seized with colicky pains, and an obstruction oc- curred at the bottom of the artificial opening, when suddenly a hard mass was shot out from the artificial anus. This substance "was found to consist of five plum-stones firmly agglu- tinated to each other. These were followed by sixteen other single plum-stones, and after- wards by a very copious feculent evacuation. On the following day three more stones found an exit, accompanied by two small bones." At different intervals the patient continued to pass plum-stones, the total number collected previous to her death being one hundred and sixteen.

Mr. Clement's account of the post-mortem conditions are highly interesting. "The cæ- cum and the ascending part of the arch of the colon appeared unusual in size, until it was suddenly cut short at the *transverse* part of the arch by the intervention of the most rigid stricture I ever felt. If a piece of whipcord had been firmly tied round this part of the in- testine, the occlusion would not have been more complete than was effected by this or- ganic change. The whole remaining portion of the transverse arch of the colon, its de- scending part, and sigmoid flexure, were col- lapsed, and formed a thin flaccid tube.

"The stricture itself was of cartilaginous hardness, and the closure of the canal so com- plete, that it would not admit of the passage even of a bristle. The extent of the stricture was not quite an inch, of a white pearly ap- pearance, perfectly smooth, and had no more apparent vascularity than a tendon.¹ The probability is, that the stricture was the result of effused fibrin, produced by the local irrita- tion, if not ulceration, from the presence of the foreign bodies."

It is still a question open to discussion, and rather to be decided by future experi- ence, how far we may be justified in open- ing the stomach for the removal of a foreign mass. It must be borne in mind that most of the cases in which a foreign body is re- tained in the stomach terminate fatally; that life in such cases is limited to a very few years, or perhaps months. The opera- tion of opening the stomach is, on the other hand, a very serious one, perhaps the most serious the surgeon can undertake; but

the constitutional irritation, which is sure to follow, has made its appearance.

SPRAINS AND RUPTURES OF THE MUSCULAR AND FIBROUS STRUCTURES.

Of all the joints of the body, none are perhaps more liable to sprains than those of the ankle. This is sufficiently accounted for by the position and functions of this joint, the small size of its articular surfaces, the great weight the astragalus has to support, and the unyielding nature of the lateral ligaments.

The immediate effects of this accident are pain, an inability to bear any weight on the limb, swelling, and afterwards ecchymosis of the soft parts around the joint; all these symptoms varying in degree and extent according to the amount of injury sustained. The remote effects which may follow this accident, if neglected or improperly treated in the first instance, are permanent lameness, from chronic inflammation of the joint; ankylosis, distortion of the foot, weakness of the ankle from relaxation of its ligaments. The lesions which are met with in sprains of the ankle vary from a slight laceration of the connective tissue, smaller bloodvessels, and a few fibres of the lateral ligaments, to a complete tearing through or detachment of the latter, laceration of the muscles and tendons or displacement of these from their sheaths, rent of the synovial membrane, and temporary dislocation of the foot, with or without fracture of one of the malleoli; indeed, the lesions of a severe sprain differ only in degree from those of a dislocation.

Sprains of the ankle are sometimes mistaken for fractures, and the latter for the former; the two injuries may also coexist.

[Mr. Callender draws attention to the fact that in some of these cases a thin film of the malleolus may be detached without any signs of crepitus. (Phil. Med. Times, Oct. 12, 1878, p. 6.)]

Sprains of the knee are by no means uncommon, and are characterized by great swelling from the effusion of fluid within the joint. Sprains of the hip and other joints of the lower extremity are less common than those of the ankle and knee, and are not likely to be mistaken for other accidents. The former may, however, resemble incipient hip-joint disease, and may, indeed, lead to its occurrence; but the error of diagnosis, so far as regards treatment, is not of practical importance.

The treatment of sprains of the lower extremity resolves itself into that for diseases of the joints generally, to which the reader is referred. In all severe sprains of the ankle, and in all cases of doubt as to the exact nature and extent of the injury, it should be treated as a fracture,

and the "immovable with starch, is the best particular lesion: the allowed to go about on a flexed and suspended the thigh as soon as possible. [The editor would in preference to some of the plaster-of-Paris splints answer a good cases. In the less severe great benefit will be found of the pure-rubber band also find an application next mentioned.] complete rupture of some tendons of the lower from violent and sudden over-stretching of the which are most frequently gastrocnemius and tendo biceps. A sudden the part, as if struck, sometimes accompanied with, and with an a symptoms which lead this injury.

The following is a probable accident. D. B., aged 17, and exerting all his heavy flagstone, heard sudden pain about the part of his left thigh; was unable to rise, brought to the Westminster saw him within one December 6, 1867, it was fracture of the thigh. were, however, wanting inability to bear any weight strongly resisted all attempts and was incapable of movement. There was no weakness of the limb. A plaster applied to the outer side was removed on the 11th; he was discharged at a full examination of the tendons, failed to detect any less muscular resistance the thigh on the pelvis at the site of the injury.

A case was under my notice in which the right ligament ruptured from a fall; its nature are reported by volume of the Pathological Transactions, p. 241, and were which usually lead to fracture.

For fuller information together with the treatment on AFFECTIONS OF THE

Wound

There are certain elements on locality, which inflicted on this part.

The sudden occurrence of shortening, then, some time after the accident, must be ascribed to the displacement of the fragments, consequent on some movements of the limb which have torn through the hitherto uninjured periosteum of the neck, or unlocked the serrations of the fractured surfaces, or converted a partial into a complete fracture; while the gradual shortening of the limb is owing to the gradual absorption of the neck of the bone.

The eversion of the limb, which is often spoken of as eversion of the foot, is really a rotation outwards of the whole limb, so that it rests on its outer surface. This position is given to it by the powerful external rotator muscles of the thigh, aided, no doubt, by the natural inclination of the limb to gravitate in the same direction. [The view of the text as to the cause of eversion has been disputed by Mr. Owen, in a paper read before the Brit. Med. Assoc. at its annual meeting, in 1879. He attributes it to the effort of the limb to seek a stable equilibrium, the support of the neck having been removed. "The limb tumbled into the position of eversion, and muscular action had nothing to do with its position." His experiments seemed to prove that his conclusion was well founded. Med. Record, vol. 16, p. 305.] The continued eversion which sometimes persists after all muscular resistance has been suspended by the action of anesthetics, can only be accounted for by the interlocking of the broken extremities of the fractured bone. The occasional occurrence of rotation of the limb inwards may be owing to the fracture having taken place while the limb was in a position of extreme inversion, the fragments having become at the same moment so locked together, as to counteract the action of the external rotator muscles. That the fixation of the limb in inversion is not due to the muscles, is proved by the following fact recorded by R. Smith; if extension be made, so as to remove the deformity and restore the length of the limb, "as soon as the extending force ceases to act, though the limb is again shortened, the foot will be found to remain everted."¹

2. *Loss of power in the limb.*—When a person has fractured his cervix femoris by a fall, or has fallen in consequence of the fracture, he is usually unable to rise, and should he succeed in doing so, he again falls. There are, however, some notable exceptions, in which patients have not only risen from the ground, but walked after the accident. These peculiarities are difficult to account for; some have attempted to explain them on the supposition of an interlocking of the fragments, others of im-

paction; and others, again, have offered by the union of the neck of the bone these hypotheses must be that loss of power of the exists without displacements, and a considerable has been observed with. Usually, the want of volition the limb is complete, aments are attended with;

3. *Crepitus.*—This is by no means easily evinced does not prove the fracture, though its presence in its favor. There are instances which may prove one of these is the draw of the fragment; hence, Sir A the limb to be first drawn rotated. But this will no fractured surfaces together; the fragment may be impacted, and push it together with the rotation the muscles may strongly of the surgeon to produce thing," observes Hamlin, never to forget, namely, many efforts to obtain a lacerate the capsule, or movement of the fragments will remedy, and which with painful manipulation occurred.

[Bigelow says: "Apart from the main object of examination with reference to treatment, fracture is loose or impacted and active flexion and rotation in search of positive signs is superfluous." "The most damaging examination is persistent rotation, and thigh, as far as a right angle to be determined are: 1. of shortening. 2d. Which rotates through an arc, loc. citat.]

4. *Swelling and pain.*—much swelling in this accident moderate amount of pain, at rest; but all movement of rotation, are attended suffering. The pain is groin and behind the trochanter increased by pressure in the

Fractures of the cervix to the capsular ligament.—principal types of extra of the femur, depending degree and direction of the duces them. In the first the bone is separated into only, by a fracture which

¹ R. W. Smith, op. cit., p. 25.

sequent shortening of the limb, as, are first set up by a blow or great trochanter; and it may lesion at a future time whether was not really broken, the injury having been overlooked. A careful examination short-accident will seldom fail to dis-true nature; but old cases of absorption of the neck of the wing a blow on the trochanter, says be distinguished from old f the same part. Ordinary or paralysis of the lower ex-n scarcely be mistaken for a et certain cases of infantile pa-some resemblance to it; thus, a running about will suddenly fall omplain of being hurt, and, be-his feet, it is found he has lost one leg. After a time the limb ortened and everted, and the of the trochanter on that side ed. Apart from the rareness re of the cervix femoris in a , it must be remarked that most

of the above symptoms only manifest themselves some months after the attack of paralysis, and are the result of atrophy of the limb, which ceases to grow at the same rate as the sound one. Examined immediately after the fall, it will be found to be simply paralytic, and there will be an absence of all the usual symptoms of fracture. But if certain accidents and diseases bear some resemblance to a fracture of the neck of the femur, so may this injury be sometimes unaccompanied by many of the symptoms which ordinarily characterize it. An example of this was given at page 933, and it may be remembered that the true nature of the lesion was only discovered after death. There are no signs by which such an injury could be recognized during life: the mode in which it happened, the age of the patient, and the pain within the joint, might lead to a suspicion of its nature, but nothing more. Such cases, however, are so rare, that nothing more need be said respecting them; but they suggest great caution in regard to the treatment of doubtful cases.

LE TO ASSIST IN THE DIAGNOSIS OF INTRA- AND EXTRACAPSULAR FRACTURES OF THE FEMUR.

Peculiar Fracture.	Extracapsular Fracture.	Extracapsular Impacted Fracture.
—Often slight or ect. Rare before fifty.	Falls on the trochanter with great force. Not peculiar to, though more common in the aged.	Falls on the trochanter with moderate force. Ditto.
More frequent in es. aling.—Not exceeding an inch. removed by moderate extension, but recurs this is remitted. n of the limb.—It on its outer side. n of trochanter.—r the iliac crest normal, moves in all arc, head of one does not move it.	Relative frequency in males and females not determined. An inch and a half to two and a half. Ditto.	Ditto. Not exceeding an inch. Cannot be overcome without using great force.
is.—Difficult to de-	Ditto.	Inclination outwards less.
ssness.—Great.	Nearer the iliac crest, often detached, does not move with the shaft.	Nearer the iliac crest, moves with the shaft, and the head of the bone moves with it.
Generally moder-	Crepitus readily detected.	None.
ig.—Generally none.	Ditto.	Limb less helpless.
	Often severe.	Generally slight.
	Frequently evident.	Not generally evident.

s.—Whether a fracture of the femur be situated within or capsular ligament, the prognosis always be guarded; lameness, or less degree, is inevitable in es; but the danger to life is not sially in the extracapsular frac-aged, the chief causes of death

being shock, irritative fever, or gradual exhaustion of the vital powers.

With reference to the proportion of deaths to recoveries, the tables of the Hôtel Dieu show a mortality of nearly one-third; but this is evidently much too high, and is attributable, according to Malgaigne, to the treatment pursued in that institution. The period at w

death ensue will be seen in the following analysis of sixty specimens of fractured cervix, contained in the Museum of the Richmond Hospital and the Richmond School of Medicine, in Dublin, and described by Dr. R. W. Smith. Of these sixty specimens, thirty-two were situated within the capsular ligament, and twenty-eight without, and of the individuals from whom the former were taken,

13	died	within	2	months.
10	"	"	1	month.
6	"	"	2	weeks.

Of the subjects of extra-capsular fracture,

19	died	within	2	months.
17	"	"	1	month.
11	"	"	2	weeks.

The above tables, which are gathered from hospital and workhouse practice, probably give a too unfavorable view of the results of this accident, and if the statistics of private practice could be obtained, it would, I believe, show a more favorable aspect. Agnew says of 176 fractures of the neck treated in the Pennsylvania Hospital only 9 died, and of this number 4¹ are recorded as intra-capsular, only 2 of which died. (Surgery, vol. i., p. 943.) Hyde reports 61 fractures of the neck treated at Bellevue Hospital, 1855-73, with 8 deaths. (N. Y. Med. Rec., July 24, 1875, p. 514.) The union of a fracture of the neck, external to the capsular ligament, takes place quite as readily as that of the shaft of the bone, and provided the age of the patient is not extreme, or the health impaired, or the accident caused by great violence, a more favorable prognosis may be given than the above [British] figures would indicate.

Fractures of the femur through the trochanter major.—"Oblique fractures," observes Sir A. Cooper, "sometimes happen through the trochanter major, without implicating the neck of the bone." "The first case of this kind I ever saw," he continues, "was in St. Thomas's Hospital, about the year 1786. It was supposed to be a fracture of the neck of the thigh-bone within the capsule, and the limb was extended over a pillow rolled under the knee, with splints on each side of the limb, by Mr. Cline's direction. An ossile union succeeded with scarcely any deformity, except that the foot was somewhat everted; and the man walked extremely well. When he was to be discharged from the hospital, a fever attacked him, of which he died; and upon dissection the fracture was found through the trochanter major, and the bone was united with very little deformity: so that his limb would have been equally useful as before." This fracture appears, from the engraving, to be situated just below the anterior inter-trochanteric line, and to intersect the trochanter near its centre, leaving part of this process connected with the neck of the bone, and the other part with the shaft.

Its distinguishing marks are, "a fixed

state of the upper part whilst its lower part the thigh-bone; even the very perceptibly the trochanter major, or free movement be of the limb, and ver its length. But when below the insertion of muscles, the lower part raised by the action mus. and the limb shortened and deform union by exuberant ment need not differ proper for fractures femur.

Separation of the femur.—"Fracture femur," observes I known in childhood, ysis is so small, as within the hip-joint, unknown, except pe

Several supposed cases have, however, been which happened to a lad had fallen out of a first left hip. The limb was but scarcely at all shortened, and he readily moved in much pain, but on beating it outwards, a sensation was frequent in the joint, as if on slipped off another. by Mr. South and Mr. of epiphyseal separation upon a double incline little inconvenience 1 times left his bed and sult of the treatment Post² also relates the case of age, whom he supposed this accident. She had making a false way, which obliged her. Dr. Post found the limb the opposite one; the swelling, but some pain the thigh; the trochanter the shaft, and there was up as a fracture, but of a quarter to half an

Fracture of the epiphysis major.—"In the foregoing shown that a simple through the trochanter the shaft or the neck also been shown the erally broken, and so

¹ Holmes, Diseases

p. 258.

² South, note to Ch

p. 565.

³ Post, New York. 190.

scapular fractures of the neck of the femur; the above title, however, would have it that it may be fractured independent of the shaft or neck of the femur, and there is certainly not sufficient evidence.

The trochanter may, however, be separated from the femur, by violence, at any period of life, before it has become united with the rest of that bone by osseous union, as in the following case, communicated to Sir A. Cooper by Mr. Aston

A young girl, about sixteen years of age, in the street tripped, and in falling her trochanter violently against the pavement. She immediately rose, and, without pain or difficulty, walked home; but, during an increase of pain, she was admitted five days afterwards, into Guy's Hospital, where she was examined by Mr. Key. The femur, which was the one injured, was completely everted, and appeared to be about an inch longer than the sound limb. It did not admit of passive motion in all directions; extension gave her considerable pain. She could not command over all the muscles, except the internal rotators. No crepitus, or displacement of bone, could be detected on the examination. Nine days after the accident she died. The post-mortem examination showed a fracture which had detached the trochanter from the body and neck of the bone, without tearing through the tendons attached to the outer side of the process; this so completely prevented all motion of the femur that the injury could not have been detected during the life of the patient. Sir A. Cooper has in his collection a well-marked example of this injury, accompanied by a fracture of the condyles. (Surgery, vol. i., Fig. 45.)]

Treatment of fracture of the neck and part of the shaft of the femur.—The fact of the possibility of bony union in intracapsular fractures being established, there are few instances in which it ought not to be attempted, and the treatment applicable to fractures of the femur in the capsule is equally proper for fractures of the neck. The indications are—if the fracture is not impacted—to bring the fragments into as accurate a relation to each other as possible, and to keep them so during a period of three or four months. There are two ways of doing this, one by the straight splint, by which extension and fixation may be caused, and the other by the double inclined plane or fracture-stand. Mr. Solly, in a clinical lecture published in the *Lancet* of August, advocates the last-named plan; while Mr. Hamilton of New York, prefers the straight position, on the ground that the patient can endure this position for a longer period with less suffering than the flexed position. A more common method in this country is to use the better, is extension by weight and pulley. In this connec-

tion we cannot refrain from again quoting from Professor Bigelow's article. "If to extend a limb means to draw it down, impacted fracture, and whatever resembles it, should never be extended, but only steadied by weight or splint. On the other hand, a loose fracture with decided shortening should be first drawn down to something like its normal length." (The italics are ours.) "Or more briefly, treatment consists in immobility, with the previous extension of a loose fracture." "The prognosis, if the patient lives, is favorable for bony union, except in the case of a loose fracture of the small part of the cervix, which if not readily distinguished, had better be disturbed as little as possible." "Whichever of these methods may be adopted, it must not be forgotten that many old people bear confinement badly: retention of urine is not uncommon, and bed-sores are by no means infrequent. Under these circumstances it may be necessary to abandon all attempts to procure union, and allow the patient to rise daily and get about on crutches, as recommended by Sir A. Cooper. In impacted fractures of the cervix, forcible extension of the limb with the view of restoring it to the same length as the other, must not be attempted, or the fragments may be unlocked, and thus placed in a less favorable condition for union. The long straight splint, used simply as a retentive and not an extending apparatus, is therefore all that is needed in this variety of fracture.

Fractures of the shaft of the femur.—These occur most frequently in its middle third. Of 70 cases observed by the writer, 46 were broken in this situation, 16 in the lower third, and 8 in the upper. ["Of 539 fractures of the thigh received into the wards of the Pennsylvania Hospital, 269 were in the middle, 151 in the lower, and 119 in the upper third."—Agnew's Surgery, vol. i., p. 946. This gives just 50 per cent. as occurring in the middle third, while the text gives 65.7 per cent.] Indirect violence occasioned the majority of these fractures; but of those due to direct causes the greatest number, both absolutely and relatively, occurred in the middle third of the bone.

It has been questioned whether a fracture of the shaft of the femur can be produced by muscular action; but of this many instances are on record, in which the production of the fracture cannot be explained in any other manner. Thus Beauchère has given an account of a man, thirty-four years of age, who, while sliding, felt himself in danger of falling backwards, and made a violent effort to keep up; he did not fall, but he heard at the instant a crack high up in the right thigh, which was

and in the meetings of the American Medical Association. The sentiment of the latter body found expression in the resolution that "shortening, in cases of fractures of the long bones, is the rule in practice, regardless of any of the means of treatment now in use." This resolution was adopted almost unanimously at the meeting in 1878, one distinguished surgeon entering his protest in the negative. In this connection it may not be superfluous to draw attention to the possible inaccuracies of measurement in the most skilful hands; but since the last edition of this work was published, one fact has been presented, which materially affects all measurements. We refer to inequality in the two limbs in uninjured persons. Cox (*Am. Journ. Med. Sciences*, April, 1875, p. 438), reports measurements on 54 individuals, in only six of whom he found the two limbs symmetrical; the difference between the two in 48 cases varied from $\frac{1}{8}$ to $\frac{1}{2}$ of an inch. To show that this difference was not entirely due to any peculiarity of the living tissues, Roberts (*Phil. Med. Times*, Aug. 3, 1878, p. 518), measured seven skeletons that showed no sign of injury, and found a difference in each case, varying from $\frac{1}{8}$ to $\frac{1}{2}$ of an inch. Granting the truth of these observations we see at once that the whole question of shortening is placed in a new light.

We think, however, that the statistics of our American surgeons, so far as they are accessible to us, give rather more favorable results than those given in the text. Thus Buck, in 1867 (*Med. Record*, April 1st), reported "89 cases in adults, in 12 of which there was no shortening; maximum 1 $\frac{1}{2}$ inches in 2; average scarcely $\frac{1}{4}$ an inch." Hyde (*Med. Record*, July 31, 1875, p. 513), reports 254 cases, age not given, both simple and compound, in which the average shortening, including 18 not shortened, was a trifle over $\frac{1}{4}$ inch. St. John (*Am. Journ. Med. Sciences*, July, 1872, p. 75), gives 50 cases of all ages, in which the average shortening was $\frac{1}{4}$ of an inch. In 18 cases it is claimed there was no shortening; 21 cases over 18 years average less than $\frac{1}{4}$ inch. Sands (*N. Y. Med. Journal*, June, 1871), gives 14 cases over 15 years, and of these in 6 cases there was no shortening; maximum 1 inch; average $\frac{1}{4}$ of an inch. Sayre (*Transactions Am. Med. Association*, 1874), reports 26 cases of all ages (19 over 20 years), in which the average shortening was less than $\frac{1}{4}$ an inch. Agnew says conclusively "that a fracture in the shaft of the thigh bone, which is cured with one-half or three-quarters of an inch shortening is a good cure, and gives no room for complaint on the part of the patient; and that the surgeon who obtains this result may walk among his professional brethren without being conscious of the least inferiority or want of skill in the management of this class of surgical injury." *Op. citat.*, p. 949.]

The causes of these different results in the adult and in the child probably depend on the different chemical composition of the bones at these two periods of life, and the modifying influence which this exerts on the form and completeness of the fracture. In the child, too, the periosteum is thicker, and in many cases only partially torn through—or not torn through at all—

so that complete displacement of the fragments does not take place.

In the treatment of fractures of the shaft in the adult, three indications should be fulfilled.—1, coaptation and fixation of the fragments; 2, moderate extension; and 3, gentle compression and support of the limb. Provided these requirements are carried out, it matters little what apparatus may be employed; but that which can be applied with the least disturbance of the fractured bone, and is most comfortable to the feelings of the patient, should be preferred. The time has gone by when the relative advantages of the straight and of the flexed position are worth discussing, the great majority of surgeons in all parts of the world being agreed on the superiority of the former. Fractures even which were thought pre-eminently to require a flexed position of the limb, as those in the upper third of the thigh, are now usually treated in the straight position. There are three principal ways of doing this: in one it is effected by means of a long splint on the outside of the limb, extending from the axilla to a few inches beyond the foot, as in the splint which goes by the name of Liston's. This provides not only for the immobility of the whole limb and trunk, but acts also as an extending apparatus. The following is the ordinary mode of applying it:

The patient lying on his back on a firm flat mattress, a few turns of a roller should be first carried round the foot and ankle; then the splint, well padded on its inner side and reaching from a point opposite the nipple to four or five inches beyond the foot, must be laid on the outside of the fractured limb, and firmly secured to the latter by several more turns of the same roller around the foot and ankle and splint, and through the notches at its lower extremity; it may then be carried upwards as high as the knee. At this stage of the proceeding traction should be steadily made on the limb by assistants, till its length equals, or even slightly exceeds, its fellow, as ascertained by measuring with a tape from the anterior superior spinous process of the ilium to the lower border of the patella. When this has been effected, the perineal bandage must be applied, its padded centre resting on the perineum, and its two ends passed through the holes in the upper part of the splint and tied on its outside. By this means the splint is prevented from ascending, and by tightening the perineal bandage, it can even be forced downwards, and powerful traction thus exerted on the limb. Lastly, the remainder of the limb should be encircled by the roller, and the upper part of the splint bound to the trunk by a few turns of a broad rib-bandage. This method of treat-

wood,¹ about four inches long, one inch broad, and half an inch thick, perforated by three holes equidistant, and just large enough to admit the cord used. By one of these holes, it is secured to the elastic. A well-padded perineal band is now applied, to the upper part of which a separate piece of cord is fastened. This is brought over the pulley at the upper end of the splint, and then made to perforate successively the two remaining holes in the piece of wood attached to the elastic. It will now be evident that, by slipping this piece of wood up the cord fastened to the perineal band, the elastic will be put on the stretch, and, in this way, extension may be regulated to a nicety.

The limb may now be brought into position, and extension applied as far as is deemed proper. In all cases I hold it to be advisable to apply short splints to the thigh; and indispensable to do so when

have been made since the publication of the last edition of this work. The most important is dispensing with the perineal band, and in place of it, raising the foot of the bed by blocks from four to six inches high, thus producing counter-extension by the weight of the patient's body. Another is the introduction of a stout rubber ring between the block in the stirrup and the cord, thus giving a certain degree of elasticity; it also serves to diminish the amount of weight necessary. But more important than the last is the application of a long splint extending from the chest below the foot with a cross-piece at its lower extremity resting upon the bed, to prevent rotation. This is more effectual than the use of sand-bags, and we think it removes entirely the only valid objection to this apparatus, viz. that it did not prevent rotation.] It is only fair to the late Mr. James of Exeter, to state that he made use of the weight

Fig. 211.

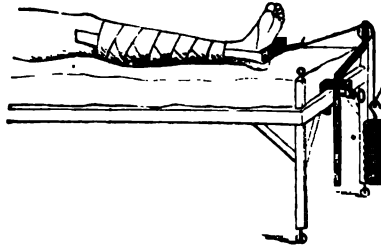


FIG. 211. Levis's attachment for weight and pulley.

the fracture is in the upper third of the bone.

Dr. Gurdon Buck believes that better results may be obtained when the extension is made by means of a weight and pulley, as seen in the engraving. [Dr. Levis has devised a very simple attachment for the weight and pulley which admits of universal application (FIG. 211) (see Phil. Med. Times, May 25, 1878).] In this apparatus the long splint is dispensed with, and the thigh only is surrounded with four short splints, while counter-extension is provided for by means of a perineal band, having its two ends made fast to the head of the bedstead. "The advantages claimed for this method over others heretofore in use, are its great simplicity of arrangement, facility of management, and especially the comfort it affords the patient during a long confinement in bed."² [One or two improvements

and pulley many years before it was employed in America.

The third mode of treating fractures of the thigh in the extended position is by one of the various forms of the so-called immovable apparatus. In spite of their unquestionable value in a large number of fractures, I must dissent from the propriety of their application to recent fractures of the thigh in the adult, on the grounds already stated against the ordinary circular bandage.

As Mr. Erichsen is, I believe, the only London surgeon of note who advocates the employment of the immovable apparatus, in recent fractures of the thigh, I here subjoin his directions for applying it. "The whole limb is enveloped in a layer of cotton-wadding, which is thickly laid along and over the osseous prominences; over this should be laid splints of thick and coarse pasteboard soaked in thin starch, properly shaped to fit the limb, extending beyond, and fixing securely the two joints above and below the fracture: the hip and knee when the thigh is broken; the knee and ankle when the leg is fractured. The pasteboard should be soft, not milled, and be doubled and torn down, not cut, as in this way the edges are not left sharp. If much strength be not required, as in children, or in some fractures of the upper extremity, a few slips of brown

¹ Similar to what is used for tightening the ropes of tents. It is used here on the same principle, and was suggested by Mr. De Morgan.

² Description of an Improved Extension-Apparatus for the Treatment of Fracture of the Thigh, etc., introduced by Gurdon Buck, M.D., Surgeon to the New York Hospital, St. Luke's Hospital, etc., etc.

a solution of alum: a little lapis powder dusted on the parts, or zinc ointment rubbed in, is an excellent preservative against inflammation and excoriation. [Hamilton recommends for these cases parallel outside splints for both limbs, extending from the axilla below the feet with a cross-bar uniting them at the bottom. Coaptation splints of felt are used over the seat of fracture (Med. Record, January 5, 1878, p. 1).] In older children, splints

Fig. 213.



of leather or gutta serena, or the immovable apparatus may be applied. Whatever plan of treatment may be selected for these fractures, it is essential to bear in mind that the amount of shortening is, to a great extent, within the control of the surgeon; and though he may fail to prevent it altogether, he may greatly diminish it by care and frequent supervision. As respects the duration of the treatment for a simple fracture of the thigh, it will average from two to three months in an adult and from six weeks to two months in a child. It is by no means necessary that patients should remain in bed all this time; six weeks will generally be long enough for an adult, and four weeks for a child; after which the immovable apparatus should be applied, and they may be allowed to go about on crutches; but they will seldom be able to dispense with all support to the limb under the period mentioned above.

In compound fractures, unless both the soft parts and bone are crushed, or the principal bloodvessels or nerves of the limb torn through, or the knee-joint opened, amputation should not be performed; but

a long interrupted splint applied on the outer side of the limb, and the wound treated on general principles. [For the treatment of compound fractures of the thigh as well as of all other limbs, we think plaster-of-Paris with fenestra presents vast advantages over all other methods. It gives ample opportunity for the application of

Fig. 214.

antiseptic dressings, and admits of such manifold variety in its application, that we would in these cases give it the highest place.] In some cases, the long splint may be dispensed with, and even the short thigh splints—extension and counter-extension being provided for by the weight and pulley, and a perineal belt, while inversion or eversion of the foot is prevented by sandbags placed on each side of the leg. Out of twenty-one cases of compound and comminuted fractures of the thigh, taken indiscriminately and treated in the above manner by Surgeon Van Steinberg, of the 53d N. Y. S. V., nineteen recovered with tolerably useful limbs.¹

¹ I. Swinburne, American Medical Times, 1863, vol. 1, p. 149.

Fractures into the knee-joint.—These may involve each or all of the bones entering into the formation of the joint, and the gravity of the accident will be in direct relation to the number of the bones implicated, their degree of comminution, and whether the fracture be simple or compound. Fractures of the femoral part of the joint may be situated either above the condyles or through them; and may be transverse, oblique, or vertical. Not unfrequently they are multiple, the two condyles being detached from the shaft by a transverse fracture, and from each other by a vertical or oblique fracture. The latter also may traverse either condyle, or the intercondyloid space. In young children the epiphysis is sometimes separated from the shaft, and this may be combined with a fracture through one of the condyles.

Chips of bone or portions of articular cartilage are also occasionally detached from the condyles into the joint, as in a case recently recorded by Professor Volkmann, of Halle, where after a heavy fall on the knee while the limb was in a state of acute flexion, a portion of the cartilage of the inner condyle, measuring nineteen mm. in diameter, was broken off, and gave rise to symptoms of "loose cartilage." Between four and five months after the accident this foreign body was extracted by an incision about two-thirds of an inch long, made directly down to it, the skin having been previously displaced so that the skin wound should not afterwards coincide with that into the joint capsule. The limb was put up into a plaster-of-Paris splint, and the patient recovered without a bad symptom.¹

Fractures of the head of the tibia are more rare, and, unless compound, they are not usually dangerous; nevertheless, lameness not unfrequently results from the inflammation which these fractures set up in the knee-joint, and the permanent stiffness which follows.

These injuries are sometimes caused by getting the leg between the spokes of a wheel in motion, by falls on the knee, or by kicks. The nature of the accident is recognized by the mobility of the fragments, the crepitus, the swelling of the joint, and the impossibility of bearing any weight on the limb.

No absolute rule can be laid down as to the position in which the limb should be placed in the several varieties of fracture. For the majority, the straight is undoubtedly the best, as the pressure of the articular surfaces on each other insures the juxtaposition of the fragments. In other cases again, it has been found that the fragments could only be kept in place by flexing the leg, and where a vertical or oblique fracture

separates the condyle may also be required. When motion arises, it may be fomentations, or even most agreeable to the patient, passive motion should be continued for six weeks to pre-

Fig.

FIG. 215. Separation of t femur, combined with frac of St. George's Hospital.)

compound fractures if tion of the limb will g [Since the general method this rule adm latitude. Many comp knee-joint have been cation of Lister's me inga. So long as the vels, nerves and musc served, an effort to s manner specified may fair hope of success.]

Fractures of

Fractures of the pat varieties as fractures may be simple, commi vertical, oblique, or caused either by direc blows upon the knee. (Of all the bones of the is most liable to be b cause; and the frequ would imply some po ture or position of thi in his Study of Frae (published in New 127 cases, of which 1 the ages of 20 and 7 number 99 were mal

¹ Deutsche Klinik, 1887, p. 448. See also Toale, Med-Chir Trans., vol. xxxix; Brod-hurst, St. George's Hospital Reports, ii. p. 41.

p. 82.] As regards structure, Malgaigne affirms that these fractures are sometimes favored by an antecedent morbid condition of the bone; but this will not explain their greater relative frequency as regards the other bones of the skeleton, unless it can be shown that the patella is more prone to this morbid change than they are. As respects position, when the knee is slightly bent, the patella is supported upon the condyles of the femur on its transverse axis only, while its upper half is unsupported behind, and its superior edge projects slightly upwards. Under these circumstances, a sudden and violent contraction of the extensor muscles of the leg, which are now nearly at right angles with the vertical axis of the patella, may snap the bone in two, as not unfrequently happens when a violent effort is made to prevent oneself falling backwards, or in voluntarily throwing oneself backwards to avoid falling forwards. Fractures of the patella by muscular action are always transverse,

Fig. 216.



FIG. 216. Separation of the fragments in moderate flexion, when the whole aponeurosis and tendon are torn.

or nearly so, and generally take place through the centre of the bone, though they may be above or below it. The frequency of fractures in this direction seems to have led English surgeons to the belief that the majority of fractures of this bone are of muscular origin. This is contrary to the experience of foreign surgeons, who attribute the greatest number of these fractures to direct violence: thus, of nine cases related by Boyer, five were caused by falls on the knee, which accident likewise produced eleven of the nineteen fractures observed by Malgaigne; while of fourteen which came under the observation of Hamilton, thirteen were the result of direct blows or falls on the knee, and only one was due solely to muscular action. [Hamilton found that the fracture was

produced by muscular action alone in 25 of 127 cases. He says: "I believe, however, that muscular action was more or less efficient in causing the fractures in all of the simple transverse fractures, and in at least one of the comminuted fractures; that is to say in 107 of the 127 cases."—*Op cit.*, p. 38.] The extent to which the fragments may become separated in transverse fractures of the patella, is subject to considerable variation, and depends chiefly on the mode in which the accident happened. In a fracture from a blow, the patient may not fall down at all; in one from a fall on the knee he falls forwards or sideways; but in a fracture from muscular action, he falls backwards, with the leg under the thigh. In the two former instances there may be little or no laceration of the fibrous structures attached to the patella, the fragments of which may be only slightly separated; but in the latter, owing to the sudden and violent contraction of the quadriceps, and the forcible flexure of the knee in falling, the soft parts will be more extensively lacerated, and the separation of the fragments correspondingly great. [Marcy (*Boston Medical and Surgical Journal*, Oct. 8, 1874, p. 364), reports a case of transverse fracture of *both* patellæ in a woman from a misstep; the separation at the time amounted to two inches. Ligamentous union with a separation of from one-quarter to half an inch supervened.] This I believe to be true, as a general rule; but in two patients recently under my care at the same time, the greater separation was in the one in which the fracture had been produced by direct violence.

[Mr. Hutchinson (*Med.-Chir. Trans.*, London, vol. 72) attributes the displacement "not to muscular traction from without, but to fluid pressure from within," and "the real cause of weak union is the bulging of fluid between the fragments." These views, although advanced more than ten years ago, have not we think received general assent.]

Symptoms and diagnosis.—The symptoms of fracture of the patella are generally well marked; when transverse, the separation of the fragments leaves a depression in front of the joint, into which the fingers may be inserted, and the condyles of the femur readily felt. Above and below this depression, the fragments of the patella may be recognized, and on bending the knee, the interval between them will be greatly increased. The power of extending the limb, or of bearing any weight upon it, is lost or impaired. In some cases little more than a transverse fissure can be detected, the bone being evidently fractured, but its fragments retained in apposition by the periosteum. In other cases symptoms are present which resemble frac-

ture, though none exists: thus a fall on the knee may tear across the fibrous capsule, and leave a transverse fissure; or a slight effusion into the bursa patellæ sometimes resembles a fracture, or the bursa may become thickened in parts, and so convey to the fingers the sensation of ridges on the surface of the bone. In vertical and comminuted fractures of this bone, the fragments can be easily brought into juxtaposition, and crepitus elicited. All the varieties of this fracture are followed by more or less inflammation in the knee joint, which not unfrequently becomes greatly distended with fluid, and thus separates still further the broken portions of bone. From this cause I have seen the nature of the injury overlooked, and the case treated as one of synovitis only.

Pathology.—It is rare for a patella which is broken transversely to become united by bone; more frequently the fragments are united by a ligamentous tissue, which varies in length from half an inch to an inch, although it may greatly exceed this, as in a specimen exhibited by the writer at the Pathological Society, figured on the present page, and where the distance between the fragments is two inches and a half. Not unfrequently, however, the fragments remain ununited, being connected with each other merely by a portion of the fibrous capsule of the knee-joint, thickened, and having incorporated with it the bursa naturally existing on the front of the patella. In this case, the aponeurotic structure may pass either from the periosteal surface of one fragment to that of the other, or it may be reflected over both fractured surfaces; or, what appears to be the most common deviation, it may pass from the periosteal surface of the upper fragment, to the articular edge of the lower, as seen in the engraving (Fig. 218). Of thirty-one specimens examined by Mr. William Adams, to whom we are indebted for these observations, fifteen were examples of ununited fracture, twelve of true ligamentous union, and four were doubtful from their being dried.¹ In these ununited fractures the fragments may be separated to the extent of five inches, whereas in true ligamentous union, the separation rarely exceeds an inch and a half. (Howe (Boston Med. and Surg. Journal, August 16, 1877, p. 179) reports 59 cases treated at the Mass. Gen. Hospital, where the average amount of separation before treatment was 1.1 inches, and after treatment 0.33 inch. In two cases there was supposed to be bony union. The writer had one case in which, after four years, not more than $\frac{1}{2}$ inch can be detected between the fragments, although at the

time of the accident. Dr. Ham says that of 127 cases distinctly stated to be five cases the bond fragments was so as to be moved upon each other, "may be constituted no union occurred." holds good as a general rule must have met with ligamentous union) fragments not being three-quarters of a the patient had been weeks or months, a wide interval between gradual yielding or the new material.

Fig. 217.

FIG. 217. Fracture of mentous tissue. (From Museum.)

FIG. 218. Fracture of union passing from the upper to the articular ment. (From St. Thom

Hamilton examined his patella fractured found the fragment ment, except on the was a separation or to the extent of a quarter explained this was removed at the e after a week more that he almost imme

¹ Transactions of the Pathological Society of London, vol. xiii., p. 179.

that this accident differed from a fracture of the bones above the ankle joint, in the absence of a sharp edge of a broken bone, and the smooth and rugous feel of the displacement, as well as in the absence of swelling occasioned by the effusion of blood. The bone was replaced without difficulty, and a starched bandage applied.¹

Treatment.—All fractures of the leg are quickly followed by more or less swelling, and there are few simple fractures which it is not advisable to put up as soon after the accident as possible. If this be deferred, the swelling increases, the sufferings of the patient are prolonged, and the cure is rendered more tedious. The mode of putting up these fractures may be varied according to the nature of the case. In some, the fragments are in such good apposition, and there is so little tendency to displacement, that it is a needless cruelty to keep the patient in bed for five or six weeks. A starch or glue bandage may therefore be put on at once, and the patient allowed to get about on crutches a few days after the accident. In other cases, the local symptoms and the general condition of the patient may be such as not to admit of this kind of treatment. [In cases of oblique fracture near the ankle Montgomery recommends the application of extension by the weight and pulley. (*Am. Journ. Med. Sci.*, April, 1871, p. 357.) Dr. S. W. Gross makes use of the same method in cases even where the obliquity is not marked. (*N. Y. Med. Record*, April 21, 1877, p. 246.) Dr. Robertson devised an exceedingly ingenious combination of extension by weight, with a modification of Smith's anterior splint, and a swing for those cases where riding of one fragment is a prominent symptom. It was used with excellent success in the Boston City Hospital. (See *Boston Med. and Surg. Journal*, May 23, 1878, p. 662.) Dr. Packard has also applied the principle of suspension to fractures of the leg, adapting it to the anterior splint and if desirable to the fracture-box. (See *Am. Journ. Med. Science*, April, 1874, p. 332.)] Thus if there should be much displacement or overlapping of the fragments, it will sometimes be found impossible to get them into place without first bending the thigh, leg, and foot at right angles with each other, and then making extension and counter-extension from the knee and ankle; and should there be a tendency to displacement of the fragments when the leg is straightened, it is advisable to keep the patient on his side

with the limb supported between Sharp's splints, and well flexed so as to relax the most powerful muscles. This is also the easiest and most natural position for the patient to lie in, and it admits of a ready examination of the limb without disturbing it, by simply unbuckling the straps and removing the upper splint. To render this method of treating fractures of the leg perfect, the splint should have a second curve, at the upper part of the leg-piece, at right angles with it, and in an opposite direction to the lower, so as to embrace the knee-joint and lower third of the thigh. With such splints, firmly securing the joints above and below the fracture, no displacement or movement of the fragments on each other could possibly happen. Indeed, Hamilton is of opinion that this, which is Pott's method slightly modified, is the best, and is applicable to nine-tenths of all simple fractures, and to some compound. In these it is necessary for one of the splints to be interrupted, and an ingenious modification of the ordinary interrupted splint has been invented by Dr. Skipton; the essential feature of which is, that it consists of several pieces, any one or more of which can be removed, so that no matter in what part of the leg the wound may be, the same splint will serve. When the fracture admits of being put up in the straight position, it is preferable in my opinion to do so, and for this, almost any of the splints or apparatus ordinarily in use will answer the purpose. [The fracture-box is a very common and popular method of treating fractures of the leg in the leading hospitals in this country. Our own experience, however, has led us to be extremely partial to plaster dressings in the treatment of these fractures. Ahl's felt splints offer a convenient and ready method of applying a splint, which has for its characteristics lightness, firmness, and adaptation to the limb.] The points to be attended to in their application, are—1, to secure the knee and ankle-joints so that no axial rotation of the fragments shall take place; 2, to see that the foot is at right angles, or nearly so, with the leg; 3, that the ball of the great toe is in a line with the inner border of the patella; and 4, that there is no shortening of the front part of the foot from the sinking back of the heel. In the last edition of this work I spoke of Neville's splint as a very efficient and simple kind of apparatus in use in St. Bartholomew's Hospital, and in the *Lancet* of February, 1868, will be found an excellent practical lecture by Mr. Paget, in which the details of its application are fully described.

¹ Preparations showing separation of the epiphyses of the lower end of the tibia and fibula, have been exhibited by Mr. Holmes, and are published in the *Path. Soc. Trans.*, vol. xlii., p. 187. See also *Diseases of Children*, 2d edit., p. 236; *New Sydenham Society's Biennial Retrospect* for 1867-8, p. 238.

It consists of a back and two side splints. The back splint is a long and nearly flat piece of iron; bent at a right angle for the foot, and

1st. All the local inflammatory mischief and general febrile disturbance which follow severe injuries, are due to the irritating and poisoning influence of decomposing blood or sloughs. 2d. This decomposition is owing to the presence of minute organisms suspended in the air. 3d. To prevent this decomposition, with its attendant evils, it is necessary to apply as a dressing to wounds, some material capable of destroying the life of the floating particles. 4th. Carbolic acid, from its destructive influence on low forms of life, is the most powerful antiseptic with which we are acquainted, and hence the most proper dressing for wounds.

The preparations employed by Mr. Lister,¹ are the carbolic oil, carbolic lotion, and carbolic paste. The composition of the first is, carbolic acid one part, boiled linseed oil five parts; that of the second, carbolic acid one part, water twenty parts; and that of the third, carbolic oil, with whitening in the proportions requisite to form a soft putty. In the treatment of bad compound fractures of the leg,

plete. [For a more full account of the various methods of applying the antiseptic method of treating wounds, and for the modifications that have been introduced by Mr. Lister himself, we refer the reader to the article on Operative Surgery.] At a later period of the treatment, it is sometimes desirable to release the patient from the position which was adopted in the first instance, and to swing the leg in a cradle, of which one of the best is that of Mr. James Salter.¹ [Dr. Van Wagenen, while house surgeon at Bellevue Hospital, devised an extremely simple and cheap method of suspending the leg, which leaves little to be desired. It consists of an elbow of wood projecting over the foot of the bed, from which the leg is suspended by two pieces of rubber tubing; one above the ankle, the other just below the knee. "The tubes have common grooved iron pulleys or wheels at each end. Those above rolling on a large iron wire" (in slots cut in the horizontal) "to allow motion towards the head or foot of the bed; those below at right angles to the others, holding the rings of rope in which the leg rotates, this last being by far the most important, allowing the patient to turn on either side." The screw of the pulley is pushed into the tube and fastened by a few turns of fine copper wire, and a bit

Fig. 222.

FIG. 222. Salter's Swing.

Mr. Lister first swabs all the recesses of the wound with a piece of rag dipped in strong carbolic acid; a rag dipped in carbolic oil is then placed over the wound, and maintained there permanently; while the paste is laid on outside this, and overlaps the sound skin for a considerable distance. "The putty should be in a layer of a quarter of an inch thick, and may be advantageously applied rolled up between two pieces of thin calico." To prevent evaporation of the acid, the paste should be covered with tinfoil strengthened with adhesive plaster. As long as any discharge continues, the paste should be changed daily, but when it has ceased, it is discontinued. The original oiled rag is left adhering to the skin, till healing by scabbing is supposed to be com-

of bent wire acts as a shield over the pulleys running in the slot, and sustains the weight of the bedclothes. (See Med. Rec., April 1, 1873, p. 145.) This differs from all others in the greater freedom of movement it allows to the patient without risking the disturbance of the fracture.

Fractures of the fibula.—Any part of this bone may be broken by direct violence, and the fracture be unaccompanied by displacement or other injury; but most frequently the bone yields to indirect force, at a point from two to four inches above the

¹ See British Medical Journal, Sept. 21, 1867; also Jan. 4, 1868 [and many later articles].

¹ "On a New Swinging Apparatus for the Treatment of Fractures of the Leg," by S. James A. Salter, M.B., etc., in Provincial Med. and Surg. Journal, 1850, p. 564.

have subsided, when some of the forms of the immovable apparatus may be substituted, and the patient allowed to go about on crutches. The apparatus should be worn for two months before attempting to use the foot. Fractures of the metatarsal bones and phalanges are always the result of direct violence, and, if simple, require no treatment but rest, and the ordinary remedies to subdue inflammation. If compound, the treatment must be regulated by the number of bones fractured, their degree of comminution or displacement, and the condition of the soft parts; if the latter are not bruised beyond recovery, and if the former can be replaced, and the constitution of the patient is good, an attempt should be made to save the foot. Under opposite circumstances, the injured parts should be removed, care being taken to leave as much of the sound portions as shall insure a useful stump.

DISLOCATIONS.

Dislocations of the Hip.

The head of the thigh-bone, though lodged in a deep cavity, to which it is accurately adapted, and in which it is retained by atmospheric pressure, and by strong ligaments and muscles, is yet more frequently displaced than these physical and anatomical dispositions would seem to admit of. Indeed, if reliance is to be placed on the statistics of this accident collected by M. Malgaigne at the Hôtel Dieu, there is no joint of the lower extremity in which dislocation occurs so frequently as in the hip: next to the shoulder, it is the most liable to this accident of any joint in the body, as seen in the following table.¹

In 491 cases of dislocation, there were—

Shoulder	321	Wrist	13
Hip	34	Fingers	7
Clavicle	33	Jaw	7
Elbow	26	Knee	6
Foot	20	Radius	4
Thumb	17	Patella	2
		Spine	1

This great proneness to displacement of the shoulder and hip-joints is doubtless owing in part to their extensive range of motion, and in part to the powerful leverage which may be exerted on them by a force applied to the distal extremities of the respective limbs, or of the humerus and femur. Dislocations of the hip are nearly always accidental, and result from the application of great force; hence, we should expect to meet with them most frequently in the male sex, and at the most active

period of life; this is fully borne out by the accompanying table from Malgaigne. In fifty-one cases of dislocation of the hip, forty-two were males, and nine females; and the following were the ages of the sufferers:

At 3 years of age	1	From 45 to 60	10
From 15 to 20	8	" 60 to 85	5 ¹
" 20 to 45	27		

[Of 115 cases collected by Hamilton,² 104 were in males and 11 in females; and in 84 cases the ages were as follows:

Under 15 years	15	45 to 60 years	7
15 to 30 years	32	66 to 85 "	1]
30 to 45 "	29		

In the 56 cases of this accident collected by Sir A. Cooper, the age of the patient is not stated in 11; but in the remaining 45, I find 7 were under 20 years of age, 7 were 50 and upwards, and 31 between 20 and 50.³ The earliest recorded age at which a dislocation of the hip has occurred is six months: it was into the obturator foramen, and was easily reduced by manipulation.⁴ Although dislocation of the hip cannot usually happen without the application of great force, individuals have been met with who possessed the power of voluntarily dislocating their hip, and again reducing it, as related by Sir A. Cooper,⁵ Stanley,⁶ and Brodie.⁷

Dislocations of the hip sometimes take place spontaneously, in consequence of paralysis of the muscles external to the joint, or from disease of the joint itself; they are also occasionally met with as congenital affections, due to causes acting in utero, or to violence inflicted during birth. In the present essay we have to treat of those dislocations of the hip which result from violence; and they occur most frequently in the following directions:

1st. The head of the bone is thrown upwards, and more or less backwards, upon the dorsum ilii.

2d. Backwards, and slightly upwards, or into the ischiatic notch.

3d. Downwards and inwards, or into the obturator foramen.

4th. Upwards and inwards, or upon the body of the pubes.

[One of the most important contributions to our knowledge of this subject is the now classical work of Professor H. J. Bigelow, of Boston ("The Hip," Phila., 1869).

¹ Ibid., p. 805.

² Fract. and Dislocations, 6th ed., p. 739.

³ On Dislocations and Fractures of the Joints, 5th edition, edited by Bransby B. Cooper.

⁴ This unique case is recorded by Mr. Powdrell in the Lancet of 1868, vol. i., p. 617.

⁵ Op. cit., Case 2.

⁶ Vide Stanley, Med.-Chir. Transactions, vol. xxiv.

⁷ Brodie, On the Joints.

¹ Traité des Fractures et des Luxations, 1855, tome ii., p. 8.

found to be perfectly restored: and this is the best, and indeed the only test of reduction which is necessary.

The reduction of the dislocation into the ischiatic notch may be effected in nearly

of the extended limb inward. When the thigh is raised perpendicularly to the floor, the head of the bone is unlocked and lies below the socket, and needs only to be jerked upward into its place; or the sus-

Fig. 233.

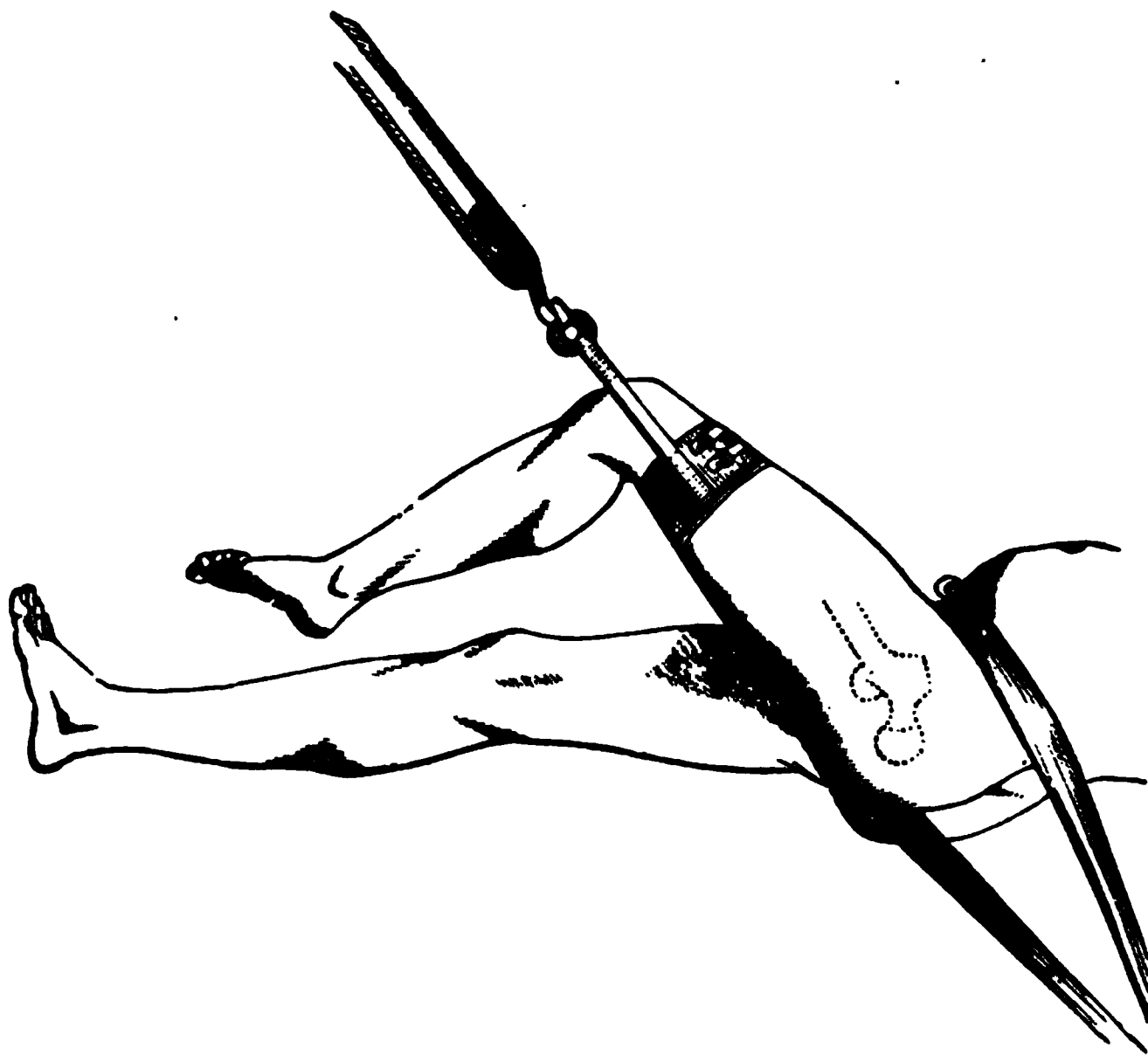


FIG. 233. Reduction of dislocation of the hip into the sciatic notch. (After Sir A. Cooper.)

the same way as the dislocation on the dorsum ilii, the chief points of difference being, that the patient should be placed on his sound side instead of on his back; that the direction of the extension should be across the middle of the sound thigh instead of immediately above the knee; and lastly, that the head of the bone should be assisted over the edge of the acetabulum, by means of a round towel placed under the upper part of the thigh and over the shoulders of an assistant, who, at the same time resting both his hands on the patient's pelvis, gradually raises his body, and so lifts the bone into its socket. Notwithstanding that the reduction of this dislocation is pronounced by Sir A. Cooper to be in general extremely difficult, the cases which he has given in illustration scarcely bear out his assertion. This is one of the forms of dislocation of the hip in which the flexion method of reduction has been practised with great success, after the ordinary means had failed. [Bigelow (op. citat., p. 67) says: "The reduction is simple. The head of the bone having reached its present position by circumduction of the flexed limb inward, must be reduced by circumduction

pendent pelvis may be depressed, or the thigh abducted and rotated outward, as in the common dorsal dislocation." "It will be observed that by the flexion method this luxation, and that upon the dorsum, are reduced in the same way, and with equal facility."'] Thus Mr. Wormald succeeded six weeks after the accident, and when pulleys had been in vain.¹

3. *Dislocation downwards and inwards, or into the obturator foramen.*—In the dislocation downwards, the head of the femur is thrown into the obturator foramen, and lies upon the obturator externus muscle; the pectineus and adductor brevis have been found torn, and the psoas and iliacus muscles, together with the glutei and the pyriformis, put on the stretch or partially lacerated.

Symptoms.—The limb is lengthened to the extent of about two inches; it is abducted and advanced in front of the other; the foot is pointed forwards, and neither inwards nor outwards. ["The limb is unequivocally flexed and abducted, the heel being raised from the floor and the

¹ Medical Times and Gazette, Aug. 16, 1856.

body is bent forwards in a stooping posture.

Diagnosis.—There is not much likelihood of either of these dislocations being mistaken for any other injury, though certain fractures in the neighborhood of the hip do occasionally resemble them. [Dr. Allis (Phila. Med. Times, March 28, 1874, p. 404), draws attention to a sure diagnostic sign of the dislocation of the sciatic variety. It consists in first measuring the limbs extended, when the shortening, if there is any, will not exceed three-fourths of an inch. "Next compare the limbs at right angles to the trunk, and if it be a sciatic dislocation there will be a difference of at least one inch and a half; but if the meas-

happened in the following case related by Smith, and which was at first mistaken for a dislocation.

The patient was an old man, eighty years of age, who died on the fourteenth day after the accident. During life the limb was shortened two inches, the foot inverted, and the entire limb in a state of adduction; the trochanter major could be felt upon the dorsum of the ilium, a little above the situation of the sciatic notch. After death, there was found a transverse serrated fracture of the neck of the femur external to the capsule; at the line of junction of the cervix with the shaft of the bone a second fracture detached the trochanter major, which was drawn upwards and backwards, carrying with it the insertions of the pyriformis, gemelli, and obturator muscles.¹

Another fracture which somewhat resembles these dislocations is that of the acetabulum, with shortening and inversion of the limb; [See a reference to two cases in the address of Mr. Favell before the British Medical Association, 1876. (British Medical Journal, August 5, 1876, and American Journal of Medical Sciences, October, 1876, p. 578.)] but in all these fractures the shortening can be overcome by traction, and recurs when this is remitted. There is also crepitus.²

Treatment.—In nearly all dislocations of the hip it will be advisable to bring the patient under the influence of chloroform [ether] before making any attempts at reduction, and as soon as this is effected, a long splint should be applied to the outside of the limb and trunk, and not removed for two or three weeks. There are two methods of reducing these, and the other dislocations of the hip—one by means of traction, and the other by manipulation. [We presume that nearly all American surgeons of the present day have recourse to manipulation, and very generally with success. Stephen Smith (Operative Surgery, p. 152) says: "The best general rule for reducing a recent dislocation is to get the head of the femur directly below the socket, by flexing the thigh at about a right-angle, and then to lift or jerk it forcibly up into its place. This rule applies to all dislocations except the pubic, and even to that when secondary from below the socket; the reduction by the lifting method is usually instantaneous, and flexion is the basis of its success. . . . In dorsal dislocations, flex and forcibly lift; if this effort fail, flex and lift while abducting. If this fail, it will be found that

Fig. 230 a.

Fig. 230 b.

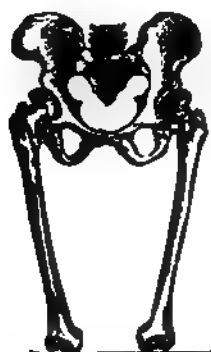


FIG. 230 a. Normal thighs and pelvis. 230 b. Dislocation into ischiatic notch. (Bryant.)

urements in both positions are the same, there cannot by any possibility be a sciatic dislocation." This depends upon the fact that in a horizontal position of the pelvis the sciatic notch lies an inch and a half below the acetabulum. "If one thigh is half an inch shorter than its fellow (as may be possible in impacted fracture) the same difference will persist in flexion, extension, abduction, or adduction. But not so in dislocation. Here the head of the bone is fixed at a point that does not correspond to the acetabulum, and in every new position, in which the limbs may be compared, a different result may be expected."³ Among these may be enumerated fractures of the neck of the femur, with inward rotation of the limb, especially if the fracture be complicated with one of the great trochanter; a portion of the latter may then be drawn by the action of the muscles towards the great sciatic notch, or upon the dorsum of the ilium, and so resemble the head of the bone in those situations, as, indeed,

[¹ Although the cut from Bryant's Surgery bears the name of Dr. Dawson, it is but fair to state that Dr. Allis's paper preceded by four years that of Dr. Dawson.]

² Op. cit., Case 29, p. 85. See also similar cases by Stanley in vol. xiii. of the Med.-Chir. Trans., p. 504.

³ For an interesting case by Mr. Birkett, in which a dislocation of the head of the femur was complicated with its fracture, the reader is referred to vol. lii. of the Med.-Chir. Trans.

ward and downward extent of its displacement. Most frequently it is lodged in the depression which exists between the tuberosity and the spine of the ischium.

the femur upwards and backwards, that being the direction of all others most protected against dislocation, by the "capsular ligament being there the strongest, the

Fig. 240.

FIG. 240. Reduction of dislocation of the hip on the pubes. (After Sir A. Cooper.)

In eight out of ten cases Malgaigne¹ found the head of the bone on a level with the spine of the ischium, while in the remaining two, it was a little below, and it may be dislocated still further backwards and downwards, into the lesser ischiatic notch. In Mr. Adams's case, exhibited at the meeting of the Pathological Society (October 19, 1869), the head of the bone rested on the body of the ischium between its spine and the acetabulum. In this case, the capsule was lacerated at its posterior part, and the obturator externus and the quadratus femoris muscles were torn through.² The symptoms of this dislocation closely resemble those of the dislocation into the ischiatic notch: the limb is flexed, adducted, and rotated inwards and slightly elongated, and the head of the bone projects backwards, though, in some cases, it could with difficulty be felt. Reduction is to be effected by extension made in the direction of the axis of the deformed limb, combined with rotation of the thigh outwards, and pressure on the head of the displaced bone.

Forwards into the perineum.—This dislocation is produced by a heavy weight falling on the back, while the body is bent forwards, and the legs are apart. The symptoms are well marked: the leg and thigh are at a right angle with the body, the toes slightly turned inwards or outwards, the natural form of the nates is lost, and the head of the femur forms a tumor, in the perineum, which moves with the limb. Reduction is effected by extension in the axis of the displaced limb, aided by manipulation.

Mechanism of dislocation of the hip.—It was long ago remarked by Sir A. Cooper, that there was something a little anomalous in the frequency of the dislocation of

edge of the acetabulum most elevated, and the ligamentum teres offering the greatest hindrance to displacement in that direction;" whereas for the dislocation into the foramen ovale, which is one of the least frequent, all the above conditions are reversed. So again, the greater prevalence of dislocation in the four usual directions, "is not to be considered as a mere matter of chance, but as the natural result of the influence of the muscles which draw the bone into these positions." He attributed therefore the occasional occurrence of the so-called anomalous dislocations, either to some mechanical obstacle, as a portion of broken bone resisting the action of the muscles, or to the latter having lost all power of contraction, as in collapse. Under these circumstances, he adds, "the head will remain where it was placed by the mere physical force which drove it from its socket."

It is obvious from the above quotations, that Sir Astley regarded the muscles as the sole agents in drawing the head of the bone into the situations where it is usually found, but he nowhere associates their action with the position of the limb which caused the dislocation; and without taking this into consideration, it would be impossible to account for the dislocation being so much more frequent on the dorsum of the ilium than in any other situation.

If we analyze the causes and symptoms of the four usual varieties of dislocation of the hip, it will be seen that they group themselves thus. In two, the head of the bone is thrown behind the acetabulum; in the other two, it is in front; and if we examine further, we shall see that the two backward dislocations are produced by forced flexion and adduction, combined probably with rotation inwards of the limb; the two forward dislocations, with forced extension and abduction combined with rotation outwards of the limb; in the former,

¹ Malgaigne, op. cit.

² Lancet, November 3, 1869, p. 640.

The limits of this article will not permit me to go into the philosophy of the so-called anomalous dislocations; but the above observations seemed necessary in order to understand the principles that should guide us in our attempts to reduce these dislocations by manipulation.

Reduction by manipulation.—The method of reducing a dislocated limb by manipulation has been practised from the earliest times, but, having fallen into desuetude, has been revived of late years, and now seems likely to supersede the traction method by pulleys. [We have preferred to direct the reader's attention to this subject in connection with the different dislocations.] The object of the movement is, of course, to bring the head of the displaced bone close to the opening in the capsule, and the best means of doing this is to make it traverse the route by which it escaped. "The reduction of a dislocation is most easy when the dislocated bone follows the same course, but in the opposite direction, to the one along which it originally passed; and the most favorable position of the limb for reduction, is that in which the displacement occurred."¹

Bearing in mind this principle, and having regard to the manner in which the dislocation occurred, it should follow that the proper manipulations for the reduction of the backward luxations, must be flexion and adduction of the limb; and for the forward, abduction and hyperextension. The first movement brings the head of the bone close to the acetabulum, the second raises it from its edge, when a slight rotation, outwards in the two backward dislocations, and inwards in the two forward, rolls the bone into the socket. The method of reduction may be formulated as follows:

1. *Dislocation backwards, iliac or ischiatic.* Flex the thigh to rather more than a right angle, adduct till the knee reaches somewhat over the opposite side of the body, and then rotate outwards, and bring downwards.

2. *Dislocation forwards, supra or infrapubic.* Abduct the thigh, rotate it somewhat outwards, and carry it into hyperextension, then rapidly rotate inwards, and place it straight.

Although most recent dislocations of the femur may be reduced with comparative ease, by one or other of the methods described in this article, cases every now and then occur in which the greatest difficulty is experienced. Excluding from consideration maladroit efforts and muscular resistance, the difficulty seems to arise from some of the following causes. 1. A portion of

the torn capsule may get in the way, as was well seen in Adams's case before cited. 2. The strong untorn portion of the capsule may offer resistance. 3. The rent in the capsule may be so small as not to admit of the return of the bone. ["If the capsular orifice is too small to allow reduction, it should be enlarged," and this may be done "at will and with impunity, by circumduction of the flexed thigh." (Bigelow, op. cit., p. 5.)] 4. A portion of the margin of the acetabulum may be broken, and so allow the capsular ligament to yield before the head of the bone.

In illustration of the two last impediments, the reader is referred to Dr. Fenner's case of dislocation on the dorsum illi; in which that gentleman divided all the muscles passing from the pelvis to the thigh, and found it still impossible to reduce the dislocation, till the rent in the capsule through which the head of the bone had escaped was enlarged from one-half to three-quarters of an inch.¹

Mr. Hamilton also exhibited, on November 28, 1868, to the Dublin Pathological Society, the preparation of a dislocation into the sciatic notch, which had taken place three weeks previously, and which it had been found impossible to reduce, after repeated attempts. The causes of failure were the smallness of the rent in the capsule, and a fracture of the lower edge of the acetabulum, so that the capsular ligament yielded before the head of the bone.² The success which sometimes attends later attempts to reduce these dislocations is probably owing to the tearing through or detachment from the femur or the acetabulum of those portions of the capsule which formed the impediment in the previous efforts.

A question which the surgeon will sometimes be called on to decide is, how long after a dislocation of the hip may its reduction be attempted? and on this point authorities differ; much must necessarily depend on the age and constitution of the patient, and something on his own wish in the matter. Fabricius Hildanus mentions the case of a lady of rank, in whom reduction was attempted fifteen weeks after the accident, but without success; it has, however been accomplished after the lapse of six months,³ twelve months,⁴ and even longer, as in the remarkable case of Mr. Cornish, related by Sir A. Cooper. Under ordinary circumstances, a reduction of the hip is hardly to be looked for later than eight weeks after the accident, which was the limit placed by the distinguished surgeon just named, beyond which it should not be attempted. Fergusson has never witnessed a successful effort beyond the

¹ Hamilton, op. cit., p. 333.

² New Sydenham Society's Biennial Report for 1867-8, p. 233.

³ Gockelius, *Gallieinum Medico-practicum*, Ulm, 1700, p. 238.

⁴ Malignan, *tom. ii.*, p. 821. Cooper, Case 64.

¹ See Arch. f. klin. Chir., vol. iv., p. 1. Professor W. Busch, *New Sydenham Society's Year-Book*, 1883.

cation of this bone is occasionally met with as a congenital defect. The writer reported in the *Am. Jour. Med. Sciences*, July, 1865, p. 82, a case of dislocation of both patellæ, which was hereditary, running through three generations.]

Outwards.—This is by far the most common variety of the accident, and may be occasioned either by muscular action or by direct violence; thus, it has been known to take place from a sudden jump on one side to avoid being run over; from wrestling; but more frequently from falling down and striking the inner side of the knee. It is said to occur generally to those who have a slight inclination of the knee inwards; but Malgaigne found only one patient so affected out of forty-six cases of this luxation.

The situation of the patella varies. When only partially dislocated, its inner half rests on the articular surface of the outer condyle, and owing to the obliquity of that surface, its outer margin becomes tilted forwards, forming a ridge in front of the condyle. In complete dislocations, the articular surface of the patella rests on the outer side of the condyle, with its inner margin directed forwards; the breadth of the knee is increased, the limb is slightly flexed and fixed, and any attempt to move it from this position causes great pain.

The dislocation *inwards* is very rare, and seldom complete, and happens usually from falls on a projecting body, by which the patella is struck on its outer edge, and so driven inwards. The symptoms resemble those of the dislocation outwards, but the projection of the patella is of course in front of the inner instead of the outer condyle.

From experiments made by Professor Streubel¹ on the dead subject, it would appear that even incomplete dislocations of the patella outwards cannot take place without laceration of the capsule of the joint; and in complete dislocations, this laceration is often very considerable. The difficulty which is sometimes experienced in reducing this dislocation, after the extensor muscles have been relaxed to the utmost, is owing to the tension of the ligaments being too great to allow of the ridge on the inner surface of the patella being raised above the process on the outer condyle. The professor was not able to produce a dislocation inwards, and he believes that it can only occur in those whose ligaments have been previously relaxed.

Treatment.—This consists in placing the patient in a sitting posture, raising the limb towards the trunk, and then pressing down that edge of the patella which is most remote from the joint; this raises the opposite

edge, and it is immediately drawn by the action of the muscles into its natural situation. In a patient who was lately under my care with this dislocation, the knee was reduced with great ease by straightening the leg, and making slight lateral pressure.

In the dislocation *edgewise* the patella is turned on its axis, so as to bring its lateral margins forwards and backwards, and its surfaces sideways; indeed, in some instances this has taken place to such an extent as almost to reverse the normal position of the two surfaces. According to Malgaigne, it is the outer edge of the bone which is most frequently directed backwards, being buried in the fossa between the condyles. [The writer finds ten cases reported, in the last ten years, in the periodicals mentioned below. In five of these the anterior surface presented outwards and in five inwards. They are to be found as follows: *Bost. Med. and Surg. Journ.*, Oct. 25, 1877, p. 487. *N. Y. Med. Rec.*, May 15, 1869, p. 123; June 15, 1869, p. 176; April 1, 1873, p. 164; Dec. 1, 1874, p. 627; Dec. 30, 1876, p. 840; Jan. 20, 1877, p. 46; Jan. 27, 1877, p. 61; May 26, 1877, p. 336; Oct. 25, 1879, p. 389.] There is no difficulty in detecting the nature of these dislocations; the patella can be easily felt in its unnatural position, causing a projection in front of the joint, and a depression on each side, while the joint is immovably fixed in an extended position. This, like the other forms of dislocation of the patella, has been known to occur from muscular action, as in jumping; but most frequently it has resulted from a sudden blow applied to the patella while the knee was bent, as in Mr. Mayo's case, related by Sir A. Cooper, of the life-guardsmen, in whom the injury was caused by the knee of another soldier, as the opposite lines rode through each other. [The case reported in the *Med. Record*, June 15, 1869, by Assist. Surg. Sternberg, U. S. Army, was caused by a similar accident; here the bone was tilted upon its outer edge, the anterior surface looking outwards.]

In a case related to me by Mr. Flower, the patient, a young man aged twenty-two, was stepping over the seats of the gallery of a theatre, and fell between them, without, so far as he was aware, striking the knee; severe pain and inability to flex the joint were the immediate results. On examination Mr. Flower found the patella twisted on its longitudinal axis, with its outer edge projecting forwards under the skin, and its inner edge wedged in between the condyles of the femur and the head of the tibia. The limb was extended, and all attempts at reduction by bending the knee, manipulating the patella, etc., produced great pain, and were unavailing till chloroform was given, when, on bending the knee, the bone directly slipped back into its place.

¹ Schmidt's *Jahrb.*, 1866, vol. cxxxix., p. 311.
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tion. In the dislocation backwards, the head of the tibia forms a projection in the ham, and a deep depression exists in front of the knee, below the projecting condyles of the femur. Thus there are the same projections and depressions as in the last described accident; but their position is reversed. The limb is extended and shortened, and the patella is placed horizontally, with its anterior surface looking downwards and its upper margin forwards. This dislocation is more rare than the preceding one.

Treatment.—The reduction of these dislocations is not difficult; extension must be made from the ankle, in the axis of the displaced tibia, and counter-extension from the thigh, aided, if necessary, by pressing the condyles of the femur upwards, and the head of the tibia downwards. After reduction is accomplished, the joint must be kept perfectly motionless for two or three weeks, and the ordinary remedies employed for preventing or subduing inflammation.

Subluxations of the semilunar cartilages. Inflammation of the knee-joint is liable to be followed by enlargement of the semilunar cartilages, and by elongation of the ligaments which connect them with the tibia. Under these circumstances, a trivial accident, such as striking the toe against some projecting object while the foot is slightly everted, as in walking; or even turning suddenly in bed, should the clothes happen to catch the point of the foot, may cause a displacement of the cartilages, and bring the condyles of the femur into direct contact with the head of the tibia. The symptoms which this gives rise to are a sudden and severe pain in the joint, with inability to straighten it, followed in a short time by the effusion of fluid, and the usual symptoms of synovitis.

Bassius recorded a case of this description in 1731. It happened in a female, who had previously been the subject of severe inflammation of the joint, which ended in enlargement of the external semilunar cartilage. One day, on attempting to put the limb to the ground, she fell down; and Bassius, who was called in, found the cartilage greatly enlarged, and projecting outwards; it was reduced by pressure, but required a plaster and bandage to retain it in its place.¹ Somewhat similar cases, attended with a marked projection of the internal semilunar cartilage, have been recorded by Malgaigne and by Dequevauviller;² Hey³ and Sir A. Cooper,⁴ on the contrary, observed no projection or other deformity; so

that the symptoms may have been due to the existence of loose cartilages in the joint. M. Gimelle⁵ has related a case in which this mistake was made; but the true cause having been at length discovered, Larrey cut into the joint and removed the foreign body.

Reduction is generally easily accomplished by flexing the knee to its utmost extent, and then suddenly straightening it, imparting to the leg at the same time a slight rotatory movement. Should these manipulations succeed, the patient will be able to extend his limb and move it freely; but the plan is not invariably successful, and it then becomes necessary—all other means of reduction failing—for the patient to wear constantly a bandage or knee-cap firmly around the joint. Even when reduction is effected, similar support of the joint is required, in order to prevent a return of the accident, to which persons who have once suffered are particularly prone. In all cases some degree of inflammation of the joint is set up, which requires the usual treatment for synovitis.

Compound dislocations.—These injuries are among the most serious to which the limbs are liable, for, to the danger incidental to every wound of a large and healthy joint, there is superadded that arising from the forcible separation and displacement of the bones which compose it, and the extensive laceration of the soft structures of and around the joint, including sometimes the popliteal artery. For these reasons it is seldom possible to save the limb, and rarely advisable to make the attempt; nevertheless, if the subject of the accident be young and of good constitution, if the wound in the integuments be small, and the soft parts around the joints not much bruised or the popliteal artery injured, an attempt may reasonably be made to preserve the limb. [The favorable results of the antiseptic method offer inducements of the strongest kind, to attempt to save limbs which hitherto would have been doomed to amputation.]

Dislocations of the head of the fibula have been occasionally met with, both from relaxation of the ligaments which connect it with the tibia, and from rupture of the same by violence.⁶ Reduction is effected by flexing the leg, so as to relax the biceps, and then pushing the head of the bone into its place, after reduction, a compress or cushion must be firmly fixed behind the head of the bone, so as to retain it in position, and it should be kept on for six weeks or two months.

Dislocations of the Ankle-joint.

In these dislocations there is a separation

¹ Malgaigne, tome II., p. 968.

² Rev. Méd.-chir, tome vi., p. 180; tome vii., p. 311.

³ Hey, Observations in Surgery, pp. 327 et seq.

⁴ Cooper, op. cit., p. 212.

⁵ Gazette médicale, 1835, p. 221.

⁶ See p. 981, for a remarkable case of this dislocation.

of the joint, is violently stretched, if not torn, and the strong ones, which fasten the tibia to the astragalus and os calcis, are always lacerated; thus producing at the same time a perfect fracture and a partial dislocation."¹

Besides the fracture of the fibula, which nearly always accompanies this dislocation, the internal lateral ligament is sometimes torn through, and there may be detached with it more or less of the internal malleolus; or the lower end of the tibia may be broken very obliquely, one portion of it remaining attached to the fibula, where it is connected with that bone by ligament. There is a remarkable if not a unique case, related by Boyer, in which this dislocation was unaccompanied by a fracture of the fibula, but in lieu of this, the bone was forced upwards, and its head dislocated from the articular facet of the tibia.²

Simple dislocation of the foot *inwards* is a rare and rather severe accident; greater force being required to produce it than the dislocation outwards; hence, in addition to the tibia being generally obliquely fractured through the malleolus, and separated from the shaft, there may also be a fracture of the astragalus, and of the outer malleolus. If there be no fracture of the latter, the external lateral ligament will be torn through; but the deltoid remains unaffected by the displacement. The symptoms of this injury are, inversion of the foot, a great prominence of the outer ankle, which almost touches the ground, and a depression on the opposite side of the ankle.

Both of these lateral dislocations are occasioned by a sudden twist of the foot outwards or inwards, as in jumping or falling from a height on the foot; and their reduction may be accomplished by extension made from the foot, the leg and thigh being previously flexed, so as to reduce to a minimum the resistance of the muscles. Two side splints, with foot-pieces made of wood, leather, or gutta-percha, or the starch-bandage strengthened with mill-board, must be applied and kept on for six weeks, the patient being allowed to go about upon crutches.

Dislocation of the foot *backwards* may arise from jumping off a carriage in motion, or from a fall backwards whilst the foot is confined; from either cause, the capsular and part of the deltoid ligaments may be ruptured, the fibula broken above the malleolus, and the tibia forced from the astragalus on to the navicular and cuneiform bones. The symptoms of this accident are, a shortening of the foot and a lengthening of the heel, with a depression above the latter. The toes are pointed

downwards, and the extremity of the tibia forms a projection in front of the ankle. Reduction may be accomplished in the same manner as in the last-described dislocation, and a similar apparatus is sufficient for the after-treatment.

Dislocations of the foot *forwards* is so rare that Sir A. Cooper never saw a case, and but few such are on record. One of the best-described cases is that recorded by Mr. R. W. Smith, of Dublin.¹

The subject of the accident was a sailor, who, while assisting to raise a very heavy cask on board ship, having at the same time one leg much flexed on the foot, and the thigh on the leg, was struck by the falling of the cask just above the knee, forcing the distal end of the tibia backwards from off the astragalus on to the upper posterior surface of the calcaneum. The symptoms of this accident were, a lengthening of the dorsum of the foot to the extent of one inch, and a shortening of the leg to the extent of half an inch, the two malleoli being that much nearer the ground. The projection of the heel had disappeared, and the tibia formed a remarkable projection in front and to the inner side of the tendo-achillis. The fibula was uninjured; but the extremity of the inner malleolus had been fractured.

The only accident with which this could be confounded is a fracture of the tibia immediately above the ankle-joint; but the situation of the malleoli would be decisive as to the nature of the injury. In the few cases of this accident which have been published, reduction was not effected, and the patients remained very lame; but there seems to be no reason why cases of this description, if seen early and properly recognized, should not be reduced in a similar manner to the lateral dislocations, and treated in all respects similarly.

Compound dislocations of the foot at the ankle-joint take place in the same directions as the simple dislocations, and are accompanied by similar injury to the ligaments and bones of the joint. There is, however, superadded the wound in the integuments communicating with the joint, and there may be also laceration of the bloodvessels and tendons, and extensive comminution of all the bones of the joint, and even of the os calcis.

It would be impossible to lay down rules for the treatment of every case; each must be studied separately, and the means adapted to the circumstances present. If arteries are wounded and bleeding, they must be tied; if bones are comminuted the pieces must be removed; resection may be required in some cases, and amputation in others. As a general rule, amputation is improper, and, except under the circumstances to be presently mentioned, the

¹ Pott's Works, by James Earle, 1790, vol. i., p. 409.

² Boyer, *Maladies chirurg.*, iii., p. 883.

¹ Dublin Quarterly Journal of Medical Science, May, 1852.

wards, which is very uncommon; and another forwards, which is still more rare. The chief lesions which are found in the simple dislocations are rupture, partial or complete, of the interosseous ligament between the os calcis and astragalus, and of the synovial capsules between these bones. The scapho-astragaloid ligament is also torn through, together with the lateral ligaments of the ankle-joint, sometimes on both sides, but more frequently on the one which is opposed to the direction of the displacement. Partial fractures of the astragalus, os calcis, or both bones, or of one or other malleolus, injury or rupture of some of the tendons, bloodvessels, or nerves, are occasionally met with in the compound varieties of this accident.

A question of some interest in connection with these displacements is, whether the scaphoid, with the rest of the foot, can be luxated from the head of the astragalus, the body of this bone retaining its connections with the os calcis through the unruptured interosseous ligament; or, to make use of the phraseology generally employed, whether the head of the astragalus can be luxated without its body undergoing displacement. Till the publication of M. Broca's memoir,¹ this form of injury was generally believed in; but that acute surgeon, arriving from the anatomical relations of the bones of the tarsus, especially those of the os calcis and cuboid, questions the possibility of its occurrence, and proves incontestably that some of the recorded examples were really luxations of the whole foot at the calcaneo-astragaloid joint, with rupture of the interosseous ligament, while others he considers had their origin in errors of diagnosis. Without doubting the frequency of diagnostic errors, most surgeons will probably be more disposed to admit with Malcagene as "*très possibles les subluxations sur le scaphoïde signalées par Bover et Richerand, et même les luxations complètes de la tête de l'astragale avec un déplacement à peine sensible du corps de l'os sur le calcaneum.*"² Indeed, the possibility of such an injury must now be considered as placed beyond a doubt by a case recorded by Pollock, in which, in a well-marked dislocation of the

foot inwards, the interosseous ligament was found to be unruptured.¹

In the dislocation of the foot backwards (commonly called dislocation of the astragalus forwards), the head of the astragalus

Fig. 244.

FIG. 244. Dislocation of the foot at the calcaneo- and scapho-astragaloid joints. The tendo-achillis is seen to have been divided, by which means the dislocation was reduced during life. After death the tarsus was put into the inverted position which it occupied at the time of the accident. a. The head of the astragalus displaced from its connection with the scaphoid. b. The interosseous calcaneo-astragaloid ligament, not completely ruptured. c. The posterior articular surface of the astragalus, marked by a slight fissure. (From the Museum of St. George's Hospital. Pollock's case.)

rests upon the instep, where it forms a tumor, projecting almost through the skin, the foot is somewhat extended and shortened in front of the leg, but elongated behind. Slight flexion and extension can be made, though attended with pain.

Perhaps the best example of this variety of dislocation is that published by Macdonnell, of which the following is an abstract. On August 6, 1834, Mr. Carmichael was riding at a brisk trot, when his horse suddenly fell. To prevent being pitched forwards, he threw himself back in the saddle, and strongly extended his legs to meet the ground. The shock of his descent was accordingly received upon the anterior extremities of the metatarsal bones, especially the metatarsal bone of the great toe of the right foot, which alone came to the ground. The following were the symptoms: "The toes were turned outwards, the inner edge of the foot forming an angle of about 30°

¹ Mémoires de la Société de Chirurgie, tome iii., p. 566.

² Op. cit., tome ii., p. 1031.

¹ Med.-Chir. Trans., vol. xlii., p. 39.

Two cases of this dislocation have been described by M. Letenneur,¹ and two by M. Malgaigne.²

Diagnosis.—There are several injuries with which dislocations of the foot at the calcaneo-astragaloid joint may be confounded, the principal of which are the following:

1. Dislocations at the ankle-joint.
2. Fractures of the tibia just above the ankle-joint.
3. Fractures of the astragalus in a horizontal or oblique direction.
4. Dislocations of the astragalus properly so called.

1. From the lateral dislocations of the foot at the ankle-joint they may be distinguished by the projection of the head of the astragalus in front of the bones of the leg, and by the persistence of the movements of flexion and extension; while fracture of the malleoli, which is the rule in dislocations at the ankle, is the exception in the corresponding sub-astragaloid dislocations. In the antero-posterior luxations at the ankle, the upper pulley-like surface of the astragalus will project either in front of or behind the leg-bones, and the whole limb will be shortened; while both these signs will be absent in the sub-astragaloid dislocations. 2. Fractures of the tibia just above the ankle-joint, with displacement of the foot backwards, also bear some resemblance to the sub-astragaloid dislocations of the foot in the same direction, but may be distinguished from them by the same signs as distinguished the luxation without fracture just given, and by the existence of crepitus; to which we may add that the dislocation consequent on fracture is rarely or never complete, and the lower sharp ridge of the broken bone can be felt projecting beneath the skin. 3. Fractures of the astragalus, when occurring in a horizontal or oblique direction, are generally accompanied with distortion, resembling somewhat the dislocations we are treating of; the foot with the lower fragment of the astragalus being carried in one direction, and the leg with the upper fragment in the opposite. These accidents, however, are rare, and, in all the recorded examples met with, were compound; so that the nature of the lesion was manifest; but in a simple fracture of this nature, the diagnosis might probably be established by the crepitation, and by the absence of the projection caused by the head of the astragalus. 4. Luxations of the astragalus from all its connections are unquestionably the accidents which have been most frequently confounded with the sub-astragaloid dislocations; but the shortening of the

leg, produced by the approximation of the tibia to the os calcis, the relation of the head of the astragalus to the malleoli, and the loss of motion of the ankle-joint, are sufficient to distinguish them.

Treatment.—What cannot fail to have struck any one who has looked over the published cases of this dislocation, and that of the astragalus with which it has been confounded, is the ease with which some of these have been reduced, and the extreme difficulty, and even impossibility, of its reduction in others. These difficulties are owing to the following circumstances.

1. The posterior edge of the astragalus may become wedged in the fossa between the articulating facets of the os calcis. This has happened in several instances, and has hitherto presented an insuperable obstacle to reduction: thus in M. Roux's case of dislocation outwards, in which amputation was performed, Nélaton found the head of the astragalus resting on the inner surface of the scaphoid bone, while the deep fissure between its two inferior articulating surfaces received a portion of the sharp margin which surrounds the articulating cavity on the posterior surface of the scaphoid; the posterior edge of the astragalus was also engaged in the fossa which separates the two superior facets of the calcaneum.¹ 2. The head of the astragalus may be driven against the tendon of the tibialis posticus muscle, and either rupture it, or escape above or below it. In the last case, the neck of this bone will be firmly constricted between the tendon and the calcaneo-scaphoid ligament; and extension made to reduce this form of dislocation will be the most effectual means of preventing it from taking place. 3. In the dislocation inwards the head of the astragalus will rupture or push before it the extensor tendons on the dorsum of the foot, and no obstacle will be presented by them to the reduction; but the scaphoid and anterior part of the foot are drawn towards the heel, so that the space between the scaphoid and os calcis, occupied normally by the under and inner part of the head of the astragalus, is obliterated by the action of the same muscles as are engaged in the production of talipes varus; chiefly the gastrocnemius and soleus, and the two tibial muscles. The dislocation forwards is so rare that no dissections, I believe, have been made to show what were the obstacles to reduction; but looking at the form of the os calcis, it would seem highly probable that it was due to the outer border of the posterior facet of the calcis being engaged in the interarticular fossa on the under surface of the astragalus. With our present knowledge, then, of the chief circumstances which have hitherto so

¹ Rev. Méd.-Chir., 1854, tome xii., p. 19.

² Malgaigne, op. cit., tome ii., p. 1044.

¹ Bull. de la Soc. anat., 1835, tome x., p. 38.

one point the bone had reached so near to the surface that vesication was produced directly over it. The anterior part of the foot appeared shortened, and a projection was presented anteriorly by the inferior extremity of the tibia. There was very little ecchymosis, and it was not at all evident upon what portion of the foot he had rested on coming to the ground. It appeared probable that the foot was suddenly and forcibly flexed, because in that movement the anterior border of the articular surface of the tibia meets the neck of the astragalus, which arrests the movement of flexion before it has proceeded far enough to produce luxation of the foot upon the leg." This conjecture of Mr. Phillips is rendered highly probable by the mode in which the luxation was produced in another case, which he describes in the same journal. The gentleman was playing at cricket, and, while running very rapidly after the ball, a gutter which was in his course was not observed. The toes rested on the further side of this gutter, while the heel was jammed directly into it, and he fell forward. The appearance of the limb in these two cases was very similar. [An extremely interesting case is reported by Dr. Cheever in the Boston Med. and Surg. Journal, August 26, 1875, where the diagnosis was fracture of the astragalus at its neck, with a dislocation of the whole body of the astragalus, inwards and backwards. Extension and counter-extension, flexion, pressure and tenotomy of the tendo-achillis, the tibial muscles and the long flexor, all proved unavailing. The leg was immovably fixed upon a curved Pott's splint, and the patient finally recovered with a tolerably useful foot.]

The dislocated astragalus, instead of being thrown directly backwards, is sometimes found on the inner or outer side of the tendo-achillis, between this and one or other of the malleoli. An example of the displacement backwards and inwards, which was reduced, occurred at University College Hospital, in the year 1839, and is reported in the July number of the *Lancet* of that year. A compound dislocation of the astragalus, backwards and outwards, which could not be reduced, and in which the bone was therefore extracted, is recorded by Turner, in his collection of cases.¹

Dislocation of the astragalus inwards and outwards.—These displacements cannot be complete without being at the same time compound, when the nature of the injury is thus rendered manifest. Even in the incomplete luxations, if the bone be not reduced, sloughing of the soft parts over the projecting astragalus takes place subsequently, and reveals the nature of the displacement. It is difficult to imagine how either of these luxations can take place without a fracture of the malleoli; yet Boyer assures us, that in a case of dislocation of the astragalus inwards, to which he was called, there was no fracture of any bone, nor any separation of the tibia from the fibula. On reading his description of

the case, it would appear to be a dislocation of the foot outwards, at the calcaneo-astragaloid joint, while at the same time the astragalus was rotated on its long axis, so as to place its upper or trochlear surface inwards, and its outer surface upwards. Thus it can scarcely be called a dislocation inwards, inasmuch as the bone did not completely leave the mortise which is formed for it by the tibia and the fibula. Two other very similar cases have been recorded by Aubray¹ and Robert² in both of which the bone had undergone the same rotation on its axis; but the displacement inwards was greater, the trochlear surface projecting in this direction beyond the inner malleolus.

Treatment.—The reduction of a complete dislocation of the astragalus, without division of the tendons which pass from the leg to the foot, would appear at first sight to be wellnigh impossible; and though several such cases have been published, it is highly probable that some of them at least were instances of partial and not of complete luxation. This difficulty of reduction is owing to the obliteration of the space normally occupied by the astragalus, through the action of the powerful muscles which pass from the thigh and leg to the foot. If moderate extension and counter-extension under chloroform, together with manipulation, fail, the tendo-achillis should be divided, and this likewise failing, the bone had better be left in its abnormal situation, and no immediate attempts made to remove it. The propriety of leaving the bone, instead of removing it in the first instance, was strongly insisted on by Sir A. Cooper; and the judiciousness of this practice has been fully proved by the more recent researches of M. Broca, who has shown that in 36 cases of irreducible simple luxation of the astragalus, in which immediate extraction of the bone was performed, 9, or one-quarter, were fatal; while in 43 irreducible cases in which no primary operation was performed, there were only 2 deaths. Of the remaining 41 cases, amputation was performed in 2; and extraction of the bone, after it had become exposed by the sloughing of the integuments, in 16; all of which recovered: while no operation of any kind was required in 23, the patients recovering with a useful limb, though of course with some deformity and lameness.³ The practice to be pursued in compound luxations of the astragalus differs from that recommended in the compound sub-astragaloid dislocations, for the reason that the bone is more completely separated from its connections, and that the space which it naturally occupies is obliterated by the ap-

¹ Aubray, *Journ. de Méd.*, 1771, tome xxxvi., p. 351.

² Robert, *Gazette des Hôpitaux*, 1846, p. 384.

³ *Gazette des Hôpitaux*, 1852, p. 371.

¹ Loc. cit.

wards are readily diagnosed by the shortening of the foot, without a corresponding elongation of the heel, and by the projection and depression on the instep. Dr. Smith, of Dublin, who has given one of the best accounts of the upward dislocation

Fig. 245.

FIG. 245. Dislocation of the metatarsus. (After R. W. Smith.)

of these bones,¹ calls attention to the peculiar alteration in the form of the sole of the foot, which, instead of presenting its natural concavity, becomes convex both in its antero-posterior and transverse diameters. The lateral displacements are readily distinguished by the projection at the inner or the outer border of the foot. In an analysis of twenty-nine cases of these tarso-metatarsal dislocations, Dr. Hitzig found thirteen were of single bones, and sixteen of the entire metatarsus. It would seem

¹ Smith, op. cit., p. 226.

also, that unreduced dislocations of the entire tarsus in a vertical direction, give rise to less inconvenience than the lateral displacements. Recent dislocations are best reduced by manual extension and counter-extension, with pressure of the thumbs on the displaced bone, under chloroform.¹

Dislocations of the phalanges are rare. Of twenty-two cases in which the first row were dislocated, Malgaigne states that nineteen were of the great toe, and three of all the toes at once. The displacements are always upwards, and may be complete or partial, and are generally compound. There is a certain analogy between the luxation of the first phalanx of the great toe and that of the corresponding phalanx of the thumb, and a similar difficulty is experienced in its reduction; this, it has been conjectured, is owing to the resistance of the internal lateral ligaments and the tendons of the short and long flexor muscles. Reduction has sometimes been effected by traction only, but at other times all means, even dividing the internal lateral ligaments and the flexor tendons, have failed. Dislocations of the second row of phalanges are so rare that Malgaigne could find but two examples of the accident on record; one was a compound dislocation affecting the great toe, and the other the third toe; both were returned. These accidents, he states, are almost peculiar to jockeys, and arise from falls from horseback with the foot underneath the animal. They have also been occasioned by the passage of carriage-wheels over the foot.

¹ New Syd. Soc. Biennial Retrospect, 1865-6, p. 273, from Berliner Klin. Wochenschrift, vol. ii., p. 39-42, 1865.

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